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Environmental Protection
Agency

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Ocean Discharge Criteria Evaluation for the Forest Oil Osprey Platform, Redoubt Shoal Unit Development Project

Cook Inlet, Alaska

NPDES Permit No. AK-053309

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ACMP	Alaska Coastal Management Program
AMSA	Area Meriting Special Attention
AOGCC	Alaska Oil and Gas Conservation Commission
bbl	barrel
BOD	biological oxygen demand
CFR	Code of Federal Regulations
CMP	Coastal Management Plan
CWA	Clean Water Act
CZMP	Coastal Zone Management Program
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FC	fecal coliform
gpd	gallons per day
gpm	gallons per minute
HPC	Habitat of Particular Concern
KPB	Kenai Peninsula Borough
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
OCS	Outer Continental Shelf
ODCE	Ocean Discharge Criteria Evaluation
ppm	parts per million
ppt	parts per thousand
TSS	total suspended solids
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

1.1 PURPOSE OF EVALUATION

The U.S. Environmental Protection Agency (EPA) intends to issue a National Pollutant Discharge Elimination System (NPDES) permit for effluent discharges associated with oil and gas production activities from the Forest Oil Osprey Platform located in Cook Inlet, Alaska (Figure 1). Section 403(c) of the Clean Water Act (CWA) requires that NPDES permits for such ocean discharges be issued in compliance with U.S. EPA's Ocean Discharge Criteria for preventing unreasonable degradation of ocean waters. The purpose of this Ocean Discharge Criteria Evaluation (ODCE) report is to identify pertinent information and concerns relative to the Ocean Discharge Criteria and drilling activities associated with the Osprey Platform.

U.S. EPA's Ocean Discharge Criteria (40 CFR Part 125, Subpart M) set forth specific determinations of unreasonable degradation that must be made prior to permit issuance. "Unreasonable degradation of the marine environment" is defined (40 CFR 125.121[e]) as follows:

- Significant adverse changes in ecosystem diversity, productivity, and stability of the biological community within the area of discharge and surrounding biological communities,
- Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms, or
- Loss of aesthetic, recreational, scientific, or economic values, which are unreasonable in relation to the benefit derived from the discharge.

This determination is to be made based on consideration of the following 10 criteria (40 CFR 125.122):

1. The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged;
2. The potential transport of such pollutants by biological, physical, or chemical processes;
3. The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain;
4. The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism;
5. The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs;

6. The potential impacts on human health through direct and indirect pathways;
7. Existing or potential recreational and commercial fishing, including finfishing and shellfishing;
8. Any applicable requirements of an approved Coastal Zone Management Plan;
9. Such other factors relating to the effects of the discharge as may be appropriate;
10. Marine water quality criteria developed pursuant to Section 304(a)(1).

If the Regional Administrator determines that the discharge will not cause unreasonable degradation of the marine environment, an NPDES permit may be issued. If the Regional Administrator determines that the discharge will cause unreasonable degradation of the marine environment, an NPDES permit may not be issued.

If the Regional Administrator has insufficient information to determine, prior to permit issuance, that there will be no unreasonable degradation of the marine environment, an NPDES permit will not be issued unless the Regional Administrator, on the basis of the best available information, determines that: 1) such discharge will not cause irreparable harm to the marine environment during the period in which monitoring will take place, 2) there are no reasonable alternatives to the onsite disposal of these materials, and 3) the discharge will be in compliance with certain specified permit conditions (40 CFR 125.122). "Irreparable harm" is defined as "significant undesirable effects occurring after the date of permit issuance which will not be reversed after cessation or modification of the discharge" (40 CFR 125.121[a]).

1.2 Scope of Evaluation

This document evaluates the impacts of waste discharges during production drilling activities as provided for by the NPDES permit proposed for the Forest Oil Osprey Platform in Cook Inlet, Alaska. The permit will authorize discharges of pollutants from facility processes, waste streams, and operations identified in the permit application. Drilling wastes, including muds, cuttings, produced water, waterflooding discharges, dewatering effluent, and other drilling fluids will be disposed of in a Class II injection well that has been permitted by the Alaska Oil and Gas Conservation Commission (AOGCC). Therefore, this ODCE focuses primarily on non-drilling waste discharges such as sanitary waste, domestic waste, deck drainage, boiler blowdown, fire control system test water, non-contact cooling water, and excess cement slurry.

Exploration drilling discharges were authorized previously under the Cook Inlet General Permit for Oil and Gas Exploration, Development, and Production Facilities (AKG 285024).

This document relies extensively on information provided in the following documents:

- *Biological Assessment for Wastewater Discharges Associated with the Osprey Platform in the Redoubt Shoal Unit Development Project* (SAIC 2001a),
- *Draft Environmental Assessment for the New Source NPDES Forest Oil Redoubt Shoal Unit Production Oil and Gas Development Project* (SAIC 2001b),
- *Revised Preliminary Ocean Discharge Criteria Evaluation, Gulf of Alaska-Cook Inlet, OCS Lease Sale 88 and State Lease Sales Located in Cook Inlet* (USEPA 1984), and
- *Ocean Discharge Criteria Evaluation for Cook Inlet (Oil and Gas Lease Sale 149) and Shelikof Strait* (Tetra Tech 1994).

Where appropriate, the reader will be referred to these publications for more detailed information concerning certain topics.

Forest Oil's Osprey Platform is located 1.8 miles southeast of the tip of the West Foreland (latitude 60° 41' 46" N, longitude 151° 40' 10" W) in central Cook Inlet (Figure 1); water depth at the platform is 45 feet (13.7 m) referenced to mean lower low water.

1.3 Overview of Report

Because drilling wastes will be reinjected, this evaluation focuses on sources, fate, and potential effects of non-drilling waste discharges on various groups of aquatic life. The types and projected quantities of discharges are detailed in Section 2.0. Anticipated amounts or volumes of wastes and their approximate chemical composition are also given. Following discharge, the fate of the wastes is examined in Section 3.0, which covers dilution, dispersion, and persistence of discharged constituents in relation to influential receiving water properties, including water depth, ice coverage, currents, wind, and waves.

Before discussing potential biological and ecological effects, an overview of aquatic communities and important species is presented in Section 4.0. The means by which waste discharges could impact marine life are presented in Section 5.0. Section 6.0 summarizes the biological assessment of endangered and threatened species (SAIC 2001a) required by the Endangered Species Act (ESA). Commercial and subsistence harvests, special aquatic sites, and coastal zone management plans in the Forelands area are discussed in Sections 7.0 and 8.0. Section 9.0 discusses the compliance of expected waste discharges with EPA water quality criteria. Section 10 summarizes the findings of this report.

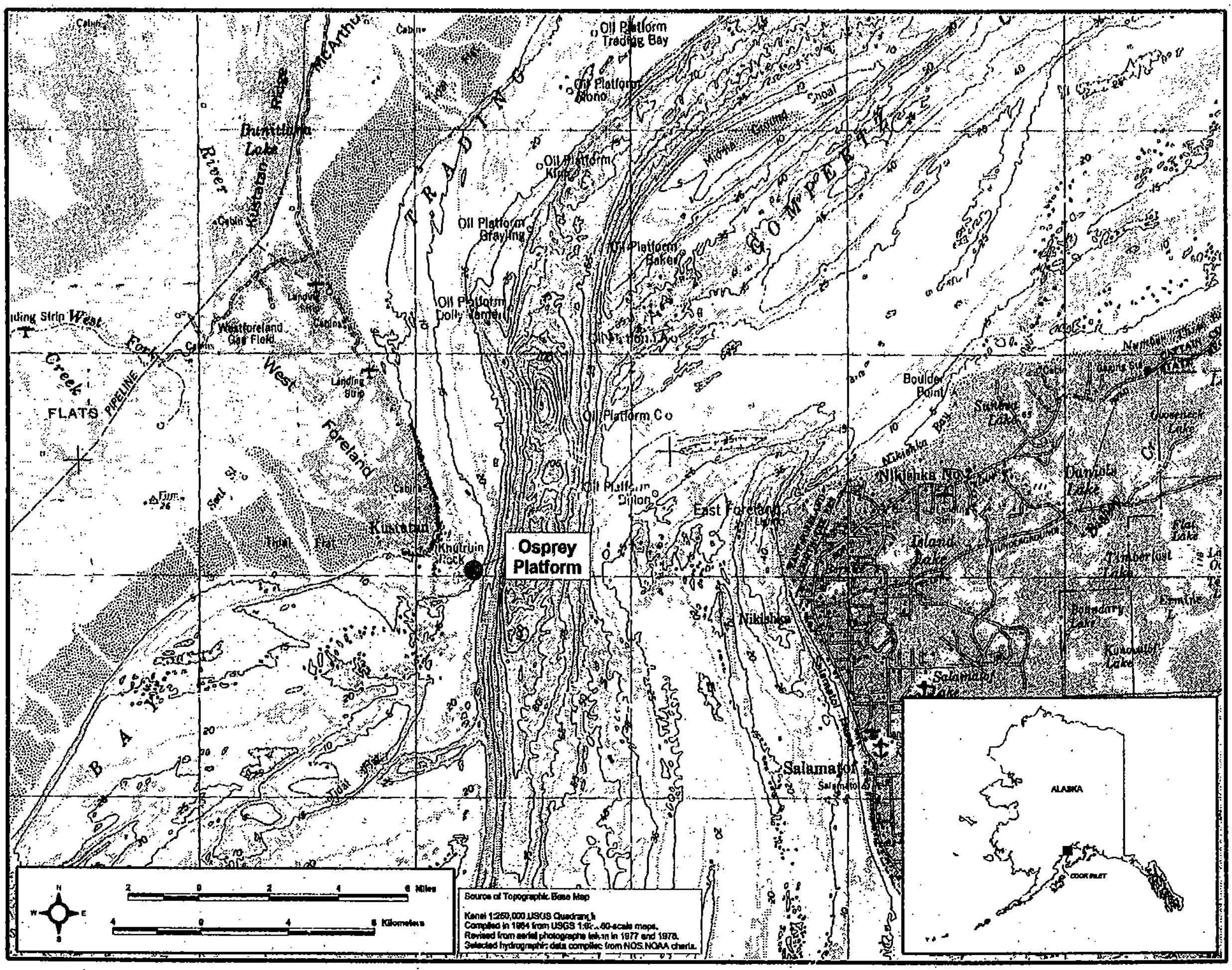

Figure 1
Location of the Osprey Platform in the Redoubt Shoal Unit Development Area, Cook Inlet, Alaska

2.0 COMPOSITION AND QUANTITIES OF MATERIALS DISCHARGED

2.1 TYPES OF DISCHARGES

Production well drilling and development can produce a wide range of waste materials related to the drilling process, maintenance of equipment, and personnel housing. Potential discharges from development and production drilling activities at the Osprey Platform include:

- drilling fluids (muds) – used in the rotary drilling of wells to clean and condition the hole, to counterbalance formation pressure, and to transport drill cuttings to the surface
- drill cuttings – the particles generated by drilling into subsurface geological formations and carried to the surface with the drilling fluid
- dewatering effluent – wastewater from drilling fluid and drill cutting dewatering activities
- waterflooding discharges – discharges associated with the treatment of seawater prior to its injection into a formation to improve the flow of hydrocarbons from production wells
- produced water – the water (brine) brought up from the hydrocarbon-bearing strata during the extraction of oil and gas
- well completion fluids – salt solutions, weighted brines, polymers, and various additives used to prevent damage to the wellbore during operations which prepare the drilled well for hydrocarbon production
- workover fluids – salt solutions, weighted brines, polymers, or other specialty additives used in a producing well to allow safe repair and maintenance or abandonment procedures
- well treatment fluids – any fluid used to restore or improve productivity by chemically or physically altering hydrocarbon-bearing strata after a well has been drilled
- test fluids – discharges that occur if hydrocarbons located during exploratory drilling are tested for formation pressure and content
- produced solids – sands and other solids deposited from produced water which collect in vessels and lines and which must be removed to maintain adequate vessel and line capacities.

These drilling-related wastes will not be discharged to Cook Inlet as part of the production drilling operations at the Osprey Platform. Drilling muds and cuttings will be disposed of by grinding the muds and cuttings and injecting them into a Class II injection well located beneath the Osprey Platform. This process will be continuous and will not require storage of drilling effluents onboard the platform. The injection well will be constructed, tested, and operated in accordance with approved AOGCC procedures. All drilling-related wastes described above will be reinjected.

Waste discharges that will be authorized under the proposed NPDES permit include: deck drainage; sanitary waste; domestic waste; boiler blowdown; fire control system test water; non-contact cooling water; and excess cement slurry. These waste streams and their disposition are discussed in the following sections.

2.2 Permitted Discharges from the Osprey Platform

The following discharges were identified on Forest Oil's NPDES permit application for the Osprey Platform (Amundsen 2000a) and will be authorized under the proposed NPDES permit. The volume, frequency, and composition of these discharges is summarized in Table 1. All waste discharges will be in accordance with the appropriate water quality standards (18 AAC 70, 18 AAC 72, 40 CFR 133.105).

2.2.1 Deck Drainage

Deck drainage refers to any waste resulting from platform washing, deck washing, spillage, rainwater, and runoff from curbs, gutters, and drains, including drip pans and wash areas. This could also include pollutants, such as detergents used in platform and equipment washing, oil, grease, and drilling fluids spilled during normal operations (Avanti 1992). Oil concentrations in deck drainage are estimated at 24 to 450 mg/L (USEPA 1996). On the Osprey Platform, contaminated deck drainage will be treated through an oil-water separator prior to discharge (Amundsen 2000a). Non-contaminated deck drainage will be discharged with no treatment. The average flow of deck drainage from the platform will be 108,000 gallons per day (NCG 2001), depending on precipitation.

2.2.2 Sanitary Waste

Sanitary waste is human body waste discharged from toilets and urinals. The sanitary waste system on the Osprey Platform, an aerated marine sanitation device, will serve a 3- to 55-person crew residing on the platform at any one time. The expected maximum quantity of sanitary waste discharged is 2,020 gallons per day (UIG 1998 and NCG 2001). The pollutants associated with this discharge include suspended solids, 5-day biochemical oxygen demand (BOD_5), fecal coliform, and residual chlorine.

The effluent is anticipated to contain average concentrations of total suspended solids (TSS) of less than 50 mg/L (Amundsen 2000b). The wastewater will be chlorinated to remove fecal coliform (FC) bacteria. The effluent will be dechlorinated in-line immediately prior to discharge (UIG 1998).

2.2.3 Domestic Waste

Domestic waste (gray water) refers to materials discharged from sinks, showers, laundries, safety showers, eyewash stations, and galleys. Gray water can include kitchen solids, detergents, cleansers, oil and grease. Domestic waste will not be treated prior to discharge. The expected quantity of domestic waste discharged is 4,000 gallons per day (NCG 2001).

2.2.4 Boiler Blowdown

Boiler blowdown is the discharge of water and minerals drained from boiler drums to minimize solids build-up in the boiler. Boiler blowdown discharges are "not planned or likely, but possible to occur intermittently" (Amundsen 2000a). The expected quantity of boiler blowdown is 100 gallons per event. Boiler blowdown will be treated through an oil-water separator prior to discharge (Amundsen 2000a).

2.2.5 Fire Control System Test Water

Fire control system test water is sea water that is released during the training of personnel in fire protection, and the testing and maintenance of fire protection equipment on the platform. This discharge is intermittent, and is expected to occur approximately 12 times per year. The expected quantity of fire control system test water is 750 gallons per minute (gpm) for 30 minutes, for a total discharge per event of 22,500 gallons. Contaminated fire control system test water will be treated through an oil-water separator prior to discharge.

2.2.6 Non-Contact Cooling Water

Non-contact cooling water is sea water that is used for non-contact, once-through cooling of various pieces of machinery on the platform. The expected quantity of non-contact cooling water is 300,000 gallons per day (gpd).

Non-contact cooling water is not significantly different in composition than ambient seawater, except for an elevated temperature (estimated at 62° to 84°F; USEPA 1996). Forest Oil's permit application indicates that non-contact cooling water will be discharged at an average temperature of less than 60°F, with a maximum daily value of 70°F.

2.2.7 Excess Cement Slurry

Excess cement slurry will result from equipment washdown after cementing operations. Excess cement slurry will be discharged intermittently while drilling, depending on drilling, casing, and testing program/problems (Amundsen 2000a). Approximately 30 discharge events are anticipated per year, with a maximum discharge of 100 barrels (bbl), or 4,200 gallons, per event. This waste stream may contain up to 200,000 mg/L of total suspended solids (daily maximum). The pH may be as high as 12, with temperatures up to 80°F and oil and grease up to 50 parts per million (ppm; Amundsen 2000a). According to Forest Oil, excess cement slurry will not be treated prior to discharge.

2.3 SUMMARY

Approximately 16 wells are expected to be drilled from the Osprey Platform during the production phase of the Redoubt Shoal Unit Development Project. Each well would take about one to two months to drill (NCG 2001). Production activities are expected to continue for approximately 20 years (Amundsen 2001). Drilling wastes including muds, cuttings, and produced water will be reinjected in a Class II injection well that has been permitted with the AOGCC. Seven waste streams will be discharged to Cook Inlet waters: deck drainage, sanitary waste, domestic waste, boiler blowdown, fire control test water, non-contact cooling water, and excess cement slurry. Deck drainage and non-contact cooling water represent relatively high volume discharges (e.g., over 100,000 gpd), however pollutant concentrations in these discharges (primarily oil and grease) are predicted to be low. Discharge of sanitary wastes will result in the discharge of suspended solids, BOD_5, fecal coliform, and residual chlorine; however, concentrations are anticipated to be in accordance with appropriate water quality standards for the state of Alaska. The other discharges (domestic waste, boiler blowdown, fire control test water, and excess cement slurry) are low in volume or intermittent and contain minimal concentrations of contaminants.

Table 1
Summary of Proposed Discharges from the Osprey Platform

Effluent	Volume of Discharge	Frequency of Discharge	Parameter	Maximum Daily Level	Average Daily Level
Deck Drainage	108,000 gpd	daily	Temperature Oil & Grease	<70° F No Sheen	<60° F No Sheen
Domestic Waste	4,000 gpd	daily			
Boiler Blowdown	100 gallons/event	weekly			
Fire Control Test Water	22,500 gallons/event	monthly			
Non-Contact Cooling Water	300,000 gpd	daily			
Sanitary Waste	2,020 gpd	daily	BOD	60 mg/L	<60 mg/L
			TSS	60 mg/L	<60 mg/L
			Temperature	<70° F	<60° F
			Oil & Grease	No Sheen	No Sheen
			Total Chlorine	>1 ppm	>1 ppm
Excess Cement Slurry	4,200 gallons/event	30 events/year	TSS	<200,000 mg/L	<100,000 mg/L
			Temperature	<80° F	<60° F
			pH	<12	<9
			Oil & Grease	No Sheen	No Sheen

Source: NPDES Permit Application, submitted to EPA on 2/29/2000 (Amundsen 2000a)

3.0 TRANSPORT, PERSISTENCE, AND FATE OF MATERIALS DISCHARGED

3.1 TRANSPORT AND PERSISTENCE

Factors influencing the transport and persistence of discharged pollutants include oceanographic characteristics of the receiving water, meteorologic conditions, characteristics of the discharge, depth of discharge, discharge rate, and method of disposal.

Transport and persistence studies conducted for Outer Continental Shelf (OCS) lease areas in high energy conditions, similar to those in Cook Inlet, are summarized in USEPA 1984. The following conclusions were made with regard to discharge of drilling muds and cuttings:

- Drilling materials discharged into the marine environment tend to be rapidly diluted and dispersed.
- Effluent concentrations may be reduced by three to five orders of magnitude within 100 m (330 feet) of the discharge point, and by five to six orders of magnitude within 800 m (2,600 feet).
- Greatest deposition usually occurs directly below or slightly downcurrent of the discharge site. The majority of sedimentation occurs within 100 m (330 feet), and background concentrations of trace metals and suspended solids are approached within 1,000 m (3,300 feet).
- Wave and current activity strongly influence surficial accumulation of pollutants.

Brandsma (1999) determined that the high suspended solids discharge of drilling muds in Cook Inlet would be reduced more than two orders of magnitude within 100 meters under the least turbulent conditions, and three orders of magnitude under more turbulent conditions.

The Osprey Platform will not discharge drilling muds and cuttings, however dilution and dispersion of sanitary and other waste streams is likely to be consistent with the above conclusions.

Detailed oceanographic data on the environment of Cook Inlet are provided in USEPA 1984, Tetra Tech 1994, and SAIC 2001a and b. Oceanographic and meteorologic conditions in the vicinity of the Osprey Platform are briefly described in the following sections. Characteristics of the discharge, including composition and discharge rate, were described in Section 2. Domestic and sanitary wastes will be discharged below the surface; no discharge will occur in water depths less than 5 m (mean lower low water).

3.1.1 Oceanography

Cook Inlet is a tidal estuary approximately 180 miles long and 60 miles wide at its mouth, with a general northeast-southwest orientation. It is divided naturally into the upper and lower inlet by the East and West Forelands, at which point the inlet is approximately 10 miles wide. The project area is located in the vicinity of the West Foreland (see Figure 1).

The upper Cook Inlet is typically about 17 to 19 miles wide and has relatively shallow water depths. Water depths are 100 to 200 feet (below mean lower low water-MLLW), but can exceed 500 feet in deeper channels closer to the Forelands. Water depths at the Osprey Platform location and along the proposed pipeline route are 45 feet (about 14 m below MLLW) or less.

Tides in Cook Inlet are classified as mixed, having strong diurnal and semi-diurnal components, and are characterized by two unequal high and low tides occurring over a period of approximately one day, with the mean range increasing northward (MMS 1995). Currents in the upper Cook Inlet are predominantly tidally driven. Current speeds are primarily a function of the tidal range, and their directions typically parallel the bathymetric contours. Near the mouths of major rivers, such as the Susitna River, currents may locally influence both the current speed and direction by the large volume of fresh water inflow.

Surface currents in the general vicinity of the Osprey Platform are expected to have mean peak velocities of approximately 4 knots, with flood tides flowing generally in a northeasterly direction and ebb currents flowing in a southerly direction. Surface currents along the pipeline route will have current speeds decreasing towards the landfall at the West Foreland (NCG 2001). Current directions will generally parallel the bathymetric contours. Higher peak currents may occur with high tidal ranges, and lower peak currents will occur with lower tidal ranges. Because of bottom friction, currents near the seafloor will be lower, possibly 10 percent of the surface currents within a foot of the seafloor.

Strong tidal currents also produce pronounced and persistent tidal rips at various locations in the inlet. It is believed that these features occur primarily at locations of relatively abrupt bathymetric changes. Tidal rips can be marked by surface debris and steep waves. They can also be hazardous to small boat traffic, however tidal rips would not typically be a significant problem for platform, pipeline, or rig boat operations. It has also been hypothesized that the tidal rips are important habitat to marine species. A consistent rip area occurs within a half mile east of the platform; the platform was originally sited to avoid the rip area and deeper waters to the east (NCG 2001).

A general circulation pattern is also present throughout the inlet. Limited circulation information for the upper inlet suggests that there may be a net southwesterly flow along the western side of the inlet, primarily as a result of freshwater inflows near the head of the inlet (Susitna River and from the Knik and Turnagain Arms). Below the Forelands, oceanic waters most commonly flow up the eastern side and turbid and fresher waters flow southward along the western side.

Waves in upper and central Cook Inlet are fetch and depth limited, and wave heights are usually less than 10 feet. In storms, waves in the upper inlet (Beluga area) can reach 15 feet (USCOE 1993) with wave periods estimated up to 6 to 8 seconds.

Ice is present in Cook Inlet for up to five months each year, but can vary greatly from year to year. On average, ice will be present in the inlet from late November through early April. Three forms of ice normally occur in the inlet: sea ice, beach ice, and river ice. Sea ice is the predominant type and is formed by freezing of the inlet water from the surface downward. Because of the strong tidal currents, ice does not occur as a continuous sheet but as ice pans. Pans can form up to 3 feet thick and be 1,000 feet (or greater) across. They can also form pressure ridges reportedly up to 18 feet high (Gatto 1976). Sea ice generally forms in October or November, gradually increasing from October to February from the West Foreland to Cape Douglas, and melts in March to April (Brower et al. 1988). The primary factor for sea ice formation in upper Cook Inlet is air temperature, and for lower Cook Inlet is the Alaska Coastal Current temperature and inflow rate (Poole and Hufford 1982).

Beach ice, or stamukhi, forms on tidal flats as seawater contacts cold tidal muds. The thickness of beach ice is limited only by the range of the tides and has been noted to reach 30 feet in thickness. During cold periods, beach ice normally remains on the beach; however, during warm weather in combination with high tides, it can melt free and enter the inlet. Blocks of beach ice that enter the inlet are normally relatively small (less than several tens of feet across) and have relatively low strengths.

River ice also occurs in Cook Inlet. It is a freshwater ice that is similar to sea ice except that it is relatively harder. It is often discharged into the inlet during spring breakup.

3.1.2 Meteorology

The climate of the central Cook Inlet area is characterized as transitional between maritime and continental regimes. Regional topography and water bodies heavily influence area climate. The Kenai Mountains to the south and east act as a barrier to warm, moist air from the Gulf of Alaska. Cook Inlet precipitation averages less than 20 percent of that measured on the Gulf of Alaska side of the Kenai Mountains (NCG 2001). The Alaska Range to the north provides a barrier to the cold winter air masses that dominate the Alaska Interior. Cook Inlet waters tend to moderate temperatures in the area. Occasionally, short periods of extreme cold and/or high winds occur when strong pressure gradients force cold air southward from the Interior.

Winds in the area are strongly influenced by mountains surrounding the Cook Inlet basin. During the months of September through April, prevailing winds are typically from the north or northwest. During May through August, winds prevail from the south. Mean speeds range from 5 knots in December to 7 knots in May (Brower et al. 1988). Site-specific, short-term data confirm the general trends described above. For example, winds measured at the West Foreland in 1999 and 2000 indicate that during September through April, prevailing winds are from the north-northeast and northeast. During June and July, winds prevail from the south-southwest and southwest. May and September are transition periods for these patterns (HCG 2000 a, b, c, d). Extreme winds are commonly out of the northeast or south.

3.2 SUMMARY

The Osprey Platform is located in a section of Cook Inlet which has been demonstrated to be a non-depositional, high-energy environment characterized by a cobble and sand bottom. Fast tidal currents and tremendous mixing produce rapid dispersion of the minimal concentrations of soluble and particulate pollutants. Brandsma (1999) determined that the high suspended solids discharge of drilling muds would be reduced more than two orders of magnitude within 100 meters under the least turbulent conditions, and three orders of magnitude under more turbulent conditions. It is expected that pollutants in the sanitary and other waste streams will be dissipated to undetectable concentrations within a few feet of the discharge.

4.0 Composition of Biological Communities

This section provides an overview of the biological communities found in the vicinity of the Osprey Platform in Cook Inlet. Life history and other detailed information on plankton, benthos, fish, mammals, and birds in the area is provided in *Biological Assessment for Wastewater Discharges Associated with the Osprey Platform in the Redoubt Shoal Unit Development Project* (SAIC 2001a) and *Draft Environmental Assessment for the New Source NPDES Forest Oil Redoubt Shoal Unit Production Oil and Gas Development Project, Cook Inlet, Alaska* (SAIC 2001b); a summary is provided below. Potential impacts to these groups are summarized in Section 5. Threatened and endangered species potentially present in the vicinity of the Osprey Platform, and potential effects of the waste discharges from the platform on threatened and endangered species, are described in Section 6.

4.1 Plankton

Planktonic communities typically consist of both phytoplankton and zooplankton. During summer months, lower Cook Inlet is among the most productive high-latitude shelf areas in the world (MMS 1996a). However, marine productivity in upper Cook Inlet is limited by severe turbidity and extreme tidal variations. The silt-laden waters that enter upper Cook Inlet load the inlet with sediment and retard its primary (phytoplankton) productivity (Kinney et al. 1970). Larrance et al. (1977) found that lower Cook Inlet marine productivity decreased in a northerly direction. At a station immediately south of the Forelands, the euphotic zone (the upper limit of effective light penetration for photosynthesis) was extremely shallow, ranging from 1 to 3 meters. The suspended material limits light penetration and probably causes reduced surface nitrate utilization in the spring (Sambrotto and Lorenzen 1987).

Zooplankton are used as food for fish, shellfish, marine birds, and some marine mammals. Zooplankton feed on phytoplankton, and their growth cycles respond to phytoplankton production. In the lower inlet, zooplankton populations vary seasonally with biomass reaching a low in the early spring and a peak in late spring and summer. Zooplankton is abundant in lower Cook Inlet, but occurs at much reduced levels in the upper inlet.

Impacts on the plankton communities that form the base of the marine food web may result in impacts on higher trophic organisms.

4.2 Benthic Invertebrates

In addition to high turbidity, Cook Inlet is characterized by extreme tidal fluctuations of up to 12.2 meters (NOAA 1999) that produce strong currents in excess of 8 knots (Tarbox and Thorne 1996). The amount of protected benthic habitat is likely reduced by the periodic scouring or substrate movement caused by Cook Inlet currents that bottleneck at the Forelands, near the Osprey Platform.

Mollusks, polychaetes, and bryozoans dominate the infauna of seafloor habitats in Cook Inlet. Feder et al. (1981) found over 370 invertebrate taxa in samples from lower Cook Inlet. Substrates consisting of shell debris generally have the most diverse communities and are dominated by mollusks and bryozoans (Feder and Jewett 1987). Muddy-bottom substrates are occupied by mollusks and polychaetes, while sandy-bottom substrates are dominated by mollusks. Nearshore infauna, where sediments are fine and sedimentation rates are high, consists mostly of mobile deposit-feeding organisms that are widely distributed through the area. Infaunal organisms are important trophic links for crabs, flatfishes, and other organisms common in the waters of Cook Inlet.

Epifauna are dominated by crustaceans, mollusks, and echinoderms. The percentage of sessile organisms in Cook Inlet is relatively low inshore and increases towards the continental shelf (Hood and Zimmerman 1987). Rocky-bottom areas consist of lush kelp beds with low epifaunal diversity, moderate kelp beds with well-developed sedentary and predator/scavenger invertebrates, and little or no kelp with moderately developed predator/scavenger communities and a well-developed sedentary invertebrate community (Feder and Jewett 1987).

A 16-inch diameter, 3-foot long pipe dredge was used at the Osprey Platform to collect six benthic samples. Organisms were collected after the samples were washed through a 1-mm screen, and sent to Dr. Steve Jewett at the University of Fairbanks for identification. From the samples, one complete anemone (*Metridium* sp.) and fragments of unidentified bivalves, mollusks, barnacles, hydroids, and gastropods were identified – less than 20 grams (wet weight) from a total sediment volume of 0.075 cubic meters (NCG 2001).

4.3 FISH

Few studies of marine fish in upper Cook Inlet have been published. The fish of central and lower Cook Inlet have been better studied, due in part to the numerous commercial fisheries in the area. Because of low phytoplankton productivity and the severe tidal currents, it is thought that upper Cook Inlet does not provide a plentiful primary food source or much safe habitat for fish. However, recent studies of beluga utilization of Cook Inlet may warrant further investigation of Cook Inlet forage fish (NMFS 2000a).

4.3.1 Anadromous Fish

Anadromous fish migrate through upper Cook Inlet towards spawning habitat in rivers and streams, and juveniles travel through Cook Inlet toward marine feeding areas. The Susitna River drainage is a primary source of these anadromous fish in upper Cook Inlet.

4.3.1.1 Salmon

All five Pacific salmon species: pink salmon (*Oncorhynchus gorbuscha*); chum salmon (*O. keta*); sockeye salmon (*O. nerka*); coho salmon (*O. kisutch*); and chinook or king salmon (*O. tshawytscha*) are found in Cook Inlet. Run timing and migration routes for all five salmon species overlap. In upper Cook Inlet, adult salmon inhabit marine and estuarine waters from early May to early November (ADFG 1986).

Pink salmon is typically the smallest salmon species in Cook Inlet, averaging between 3 and 5 pounds. Pink salmon enter their spawning streams between late June and October and typically spawn within a few miles of the shore, often within the intertidal zone. The eggs are buried in the gravel of stream bottoms and hatch in the winter. In spring the young emerge from the gravel and migrate downstream to salt water. Pink salmon stay close to the shore during their first summer, feeding on small organisms such as plankton, insects and young fish. At about one year of age, pink salmon move offshore to ocean feeding grounds where their food consists mainly of plankton, fish and squid. Return migration to fresh water takes place during the second summer with few exceptions. The even-year pink salmon return is typically stronger than the odd-year return in Cook Inlet (ADFG 1986).

Chum salmon grow to an average weight of between 7 and 18 pounds. Chum salmon remain nearshore during the summer where their diet consists of small insects and plankton. In the fall, they start moving offshore where they feed on plankton. They return to fresh water in the fall and spawn late in the year. Most chum salmon spawn in areas similar to those used by pink salmon, but sometimes travel great distances up large rivers (e.g. up to 2,000 miles up the Yukon River). Chum salmon usually return to streams to spawn after 3 to 5 years at sea.

Sockeye salmon spawn in stream systems with lakes; fry may reside up to three years in freshwater lakes before migrating to sea. Most sockeye spend two to three winters in the North Pacific Ocean before returning to natal streams to spawn and die. Sockeye salmon is the most important commercial salmon species in Cook Inlet (ADFG 1999).

Coho salmon return to spawn in natal stream gravels from July to November, usually the last of the five salmon species. Fry emerge in May or June and live in ponds, lakes and stream pools, feeding on drifting insects. Coho salmon may reside in-stream up to three winters before migrating to sea where they typically remain for two winters before returning to spawn (ADFG 1986).

Chinook salmon are the first of the five species to return each season. They reach the Susitna River in approximately mid-May (ADFG 1986). Soon after hatching, most juvenile chinook salmon migrate to sea, but some remain for a year in fresh water. Most chinook salmon return to natal streams to spawn in their fourth or fifth year. The Susitna River supports the largest chinook salmon run in upper Cook Inlet, which includes systems below the Forelands to the latitude of N 59° 46' 12", near Anchor Point (ADFG 1986).

4.3.1.2 Other Anadromous Fish

Bering cisco (*Coregonis laurettae*) have been reported in the Susitna River drainage (Barrett et al. 1985). Bering cisco enter river systems in the late summer. In 1982, spawning peaked mid-October in the Susitna River. Egg incubation occurs over winter and larvae move into northern Cook Inlet after ice-out in the spring from late April to May (Morrow 1980).

Dolly Varden (*Salvelinus malma*) that inhabit Cook Inlet can be anadromous or reside in fresh water. Non-resident Dolly Varden cycle seasonally between freshwater and marine environments. They often overwinter in freshwater drainages, then disperse into coastal waters during summer to feed on small fishes and marine invertebrates (Morrow 1980). In Cook Inlet, Dolly Varden spawn annually in rivers during the fall from late August to October (Scott and Crossman 1973; Morrow 1980). Like other salmonids, Dolly Varden lay eggs in hollowed-out redds (shallow cavities dug into streambeds where salmonids spawn) located in swift moving water; hatching occurs the following spring. Juvenile Dolly Varden remain in their natal streams for 2 to 3 years.

White sturgeon (*Acipenser transmontanus*) are anadromous fish found in upper Cook Inlet. They are believed to spend most of life near shore in water depths of 30 meters or less. Although little is known about white sturgeon migrations while in salt water, one tagged specimen was captured 1,056 km from where it was tagged (Morrow 1980). In the spring, most mature white sturgeon enter the estuaries and lower reaches of river systems. They spawn over rocky bottoms in swift water where the sticky eggs adhere to the river bottom. The amount of time needed for the eggs to hatch is not known. After spawning, the adults return to sea (Morrow 1980).

4.3.2 Pelagic Fish

Eulachon (*Thaleichthys pacificus*) are small anadromous forage fish (up to approximately 23 cm long; MMS 1995) found throughout Cook Inlet. Mature eulachon, typically three years old, spawn in May soon after ice-out in the lower reaches of streams and rivers. The Susitna River supports a run of eulachon estimated in the millions (ADFG 1983, Barrett et al. 1985). Females broadcast their eggs over sand or gravel substrates where the eggs anchor to sand grains. Eggs hatch in 30 to 40 days, depending on the water temperature. Eulachon larvae are then flushed out of the drainage and mature in salt water. As juveniles and adults, they feed primarily on copepods and plankton. As the spawning season approaches, eulachon gather in large schools at stream and river mouths. Most eulachon die after spawning (Hart 1973). Eulachon is most important as a food source for other fish, birds and marine mammals. The Cook Inlet population also supports small dipnet fisheries in upper Cook Inlet.

Pacific herring (*Clupea pallasi*) are a larger forage fish (up to 38 cm in Alaska; Hart 1973) that enter lower Cook Inlet to spawn in early April and possibly into the fall (MMS 1995). Female herring lay adhesive eggs over rock and seaweed substrates. Depending on water temperature, eggs hatch in three to seven weeks. Herring stay nearshore until cold winter water temperatures drive them offshore to deeper, warmer waters. Herring have been harvested for bait in Cook Inlet as far north as the Forelands (Blackburn et al. 1979). The Cook Inlet herring fishery now targets Kamishak Bay on the west side of lower Cook Inlet. A small herring sac roe fishery has been suspended since the 1998 season because of low herring abundance. Alaska Department of Fish and

Game biologists observed about 8,100 tons of herring in the Kamishak Bay District in 2000; biomass must exceed a threshold of 8,000 tons before a commercial sac roe harvest can be considered for Kamishak Bay.

Pacific sand lance (*Ammodytes hexapterus*) is a schooling fish that sometimes bury themselves in beach sand (Hart 1973). Pacific sand lance spawn within bays and estuaries, typically between December and March. Eggs are demersal, but will suspend in turbulent waters (Williams et al. 1964). Pacific sand lance larvae are found both offshore and in intertidal zones (Fitch and Lavenberg 1975, Kobayashi 1961). Early juvenile stages are pelagic, while the adult burrowing behavior develops gradually (Hart 1973). Major food items of the juvenile sand lance include copepods, other small crustaceans, and eggs of many forms (Hart 1973; Fitch and Lavenberg 1975). This species is commonly preyed upon by lingcod, chinook salmon, halibut, fur seals, and other marine animals (Hart 1973), and appears to be an important forage species. Pacific sand lance have been caught off Chisik Island, southwest of West Foreland (Fechhelm et al. 1999).

4.3.3 Groundfish

The Pacific halibut (*Hippoglossus stenolepis*) is a large flatfish that occurs throughout Cook Inlet. Halibut concentrate on spawning grounds along the edge of the continental shelf at water depths of 182 to 455 meters from November to March. Significant spawning sites in the vicinity of lower Cook Inlet are Portlock Bank, northeast of Kodiak Island, and Chirikof Island, south of Kodiak Island (IPHC 1998). Temperature influences the rate of development, but typically eggs hatch in 20 days at 5° Celsius (ADFG 1986). As eggs develop into larvae, they float in the water column and drift passively with ocean currents. Halibut larvae's specific gravity decreases as they grow. Three to five month old larvae drift in the upper 100 meters of water where they are pushed by winds to shallow sections of the continental shelf. At six months old, juveniles settle to the bottom in nearshore waters where they remain for one to three years (Best and Hardman 1982). Juvenile halibut then move further offshore (IPHC 1998). Halibut migrate seasonally from deeper water in the winter to shallow water in summer. Accordingly, the fishery is most active in deep areas early in the season (i.e. May) whereas activity can be as shallow as 20 meters during mid-summer.

A recreational fishery in central Cook Inlet targets Pacific halibut. The Sport Fish Division of the Alaska Department of Fish and Game estimate that 75,709 halibut were caught by sport fishermen in central Cook Inlet between May 1 and July 31, 1995 (McKinley 1996).

Pacific cod (*Gadus macrocephalus*) are distributed over lower Cook Inlet. They are fast-growing bottom-dwellers that mature in approximately three years. They may reach lengths of up to one meter (Hart, 1973). Cod spawn during an extended period through the winter and eggs may hatch in one week, depending on water temperature. Cod are harvested offshore in the Gulf of Alaska by trawl, longline, pot, and jig gear. Cod move into deep water in autumn and return to shallow water in spring. Pacific cod populations sustain a rapid turnover due to predation and commercial fishing. The Gulf of Alaska stock is projected to decline as a result of poor year-classes produced from 1990 through 1994 (Witherell, 1999).

Starry flounder (*Platichthys stellatus*) have been caught in central Cook Inlet (Fechhelm et al. 1999) and are likely to occur in northern Cook Inlet. Starry flounder spawn from February through April in shallow water (Hart 1973). They generally do not migrate, although one starry flounder was caught 200 km from where it had been tagged (Hart 1973). Starry flounder tolerate low salinities and some have been caught within rivers.

Arrowtooth flounder (*Atheresthes stomias*) and yellowfin sole (*Pleuronectes asper*) may also extend into Cook Inlet. Little is known about the life history of these flatfish. Arrowtooth flounder larvae have been taken from depths of 200 meters to the surface in June off British Columbia (Hart 1973). Both have been caught off Chisik Island in central Cook Inlet (Fechhelm et al. 1999).

4.3.4 Essential Fish Habitat

The 1996 amendments to the Magnuson-Stevens Act (MSA), PL-104-267, which regulate fishing in U.S. waters, included substantial new provisions to protect important habitat for all federally managed species of marine and anadromous fish. The amendment created a new requirement to describe and identify "essential fish habitat" (EFH) in each fishery management plan. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Federal agencies are required to consult with the National Marine Fisheries Service (NMFS) on all actions undertaken by the agency that may adversely affect EFH.

This mandate was intended to minimize adverse effects on habitat caused by fishing or non-fishing activities, and to identify other actions to encourage the conservation and enhancement of this habitat. Cook Inlet contains EFH for a total of 35 species including walleye pollock, Pacific cod, and salmon. Routine operations and accidents can affect EFH by damaging habitats used for breeding, spawning, feeding, or growth to maturity.

Fishery Management Plans are obliged to identify habitat areas of particular concern (HPC) within EFH. HPCs include living substrates in shallow water that provide food and rearing habitat for juvenile fish, and spawning grounds that may be impacted by shore-based activities. Estuarine and nearshore habitats of Pacific salmon (e.g. eel grass [*Zostera* sp.] beds) and herring spawning grounds (e.g. rockweed [*Fucus* sp.] and eel grass) are HPCs that can be found in Cook Inlet. Offshore HPCs include areas with substrates that serve as cover for organisms including groundfish. Areas of deepwater coral are also considered HPC, but populations are concentrated off southeast Alaska, out of the proposed project area. All anadromous streams qualify as HPC.

An EFH Assessment has been performed for the wastewater discharges from the Osprey Platform. This assessment is provided as Appendix C to the *Draft Environmental Assessment for the New Source NPDES Forest Oil Redoubt Shoal Unit Production Oil and Gas Development Project, Cook Inlet, Alaska* (SAIC 2001b).

4.4 Marine Mammals

Marine mammals that range throughout the Gulf of Alaska, including Cook Inlet, are described below. These species are protected under the Marine Mammal Protection Act (MMPA) and are managed by the U.S. Fish and Wildlife Service (USFWS) and NMFS. Threatened and endangered species of marine mammals are discussed in Section 6.

4.4.1 Minke Whale

Minke whales (*Balaenoptera acutorostrata*) occur in the North Pacific from the Bering and Chukchi Seas south to near the equator (Leatherwood et al. 1982). Minke whales are relatively common in the nearshore waters of the Gulf of Alaska (Mizroch 1992), but are not abundant in any other part of the eastern Pacific (Brueggeman et al. 1990). While Minke whales are unlikely to migrate into Cook Inlet, it could occur.

Minke whales breed in temperate or subtropical waters throughout the year (Dohl et al. 1981). Peaks of breeding activity occur in January and in June (Leatherwood et al. 1982). Calving occurs in winter and spring (Stewart and Leatherwood 1985). Females are capable of calving each year, but a two-year calving interval is more typical (Leatherwood et al. 1982).

Minke whales in the North Pacific prey mostly on euphausiids and copepods, but also feed on schooling fishes including Pacific sand lance, northern anchovy, and squid (Leatherwood et al. 1982; Stewart and Leatherwood 1985, Horwood 1990).

No estimates of the number of minke whales in the north Pacific or Alaskan waters have been made, nor are there data on trends in the minke whale population in Alaskan waters (Hill and DeMaster 2000). The annual human-caused mortality is considered insignificant. Minke whales in Alaska are not listed as depleted under the MMPA, or considered a strategic stock (Hill and DeMaster 2000).

4.4.2 Gray Whale

Gray whales (*Eschrichtius robustus*) historically inhabited both the North Atlantic and North Pacific oceans. A relic population survives in the western Pacific. The eastern Pacific or California gray whale population has recovered significantly, and now numbers about 23,000 (Hill et al. 1997). The eastern Pacific stock was removed from the Endangered Species List in 1994 and is not considered a strategic stock by the NMFS.

The eastern Pacific gray whale breeds and calves in the protected waters along the west coast of Baja California and the east coast of the Gulf of California from January to April (Swartz and Jones 1981; Jones and Swartz 1984). At the end of the breeding and calving season, most of these gray whales migrate about 8,000 km (5,000 mi.) north, generally along the west coast of North America, to the main summer feeding grounds in the northern Bering and Chukchi seas (Tomilin 1967; Rice and Wolman 1971; Braham 1984; Nerini 1984).

Gray whale occurrences in Cook Inlet are most likely uncommon. As they move through the Gulf of Alaska on their northward and southward migrations, gray whales closely follow the coastline (Calkins 1986). They generally tend to by-pass Cook Inlet as they pass through the Barren Islands and the waters south of Kodiak Island (Calkins 1986). However, a cow and a calf were observed in lower Cook Inlet as recently as the summer of 2000 (M. Eagleton, NMFS, pers. comm.).

4.4.3 Killer Whale

Killer whales (*Orcinus orca*) occur along the entire Alaska coast (Dahlheim et al. 1997) from the Chukchi Sea, into the Bering Sea, along the Aleutian Islands, Gulf of Alaska, and into Southeast

Alaska (Braham and Dahlheim 1982). Seasonal concentrations occur in Shelikof Strait and the waters around Kodiak Island (Calkins 1986). Killer whales are known to inhabit Cook Inlet waters during the summer and have been observed pursuing beluga whales in Cook Inlet (M. Eagleton, NMFS, pers. comm.). Killer whales utilizing Cook Inlet are most likely from the Eastern North Pacific Northern Resident stock of killer whales, which is estimated at 717 individuals (Hill and DeMaster 1999). Currently, there are no reliable data describing the population trend for this stock (Hill and DeMaster 1999).

4.4.4 Harbor Porpoise

The harbor porpoise (*Phocoena phocoena*) is distributed in waters along the continental shelf, and is most frequently found in cool waters with high prey concentrations (Watts and Gaskin 1985). The range of the harbor porpoise within the eastern North Pacific Ocean is primarily restricted to coastal waters and extends from Point Barrow, along the coast of Alaska, and the west coast of North America to Point Conception, California (Gaskin 1984). Harbor porpoise densities are much greater in their southern range (Washington, northern Oregon and California) than in Alaskan waters (Dahlheim et al. submitted). Harbor porpoise are not migratory. Little information on the population dynamics of harbor porpoises is known. However, harbor porpoise occur in Cook Inlet (Calkins 1983). The most recent population estimate for harbor porpoise in Alaskan waters is 30,000 (Hill and DeMaster 1999).

The major predators on harbor porpoises are great white sharks and killer whales. Unlike other delphinids, harbor porpoises forage independently (Würsig 1986) feeding on small, schooling fishes, such as northern anchovy and Pacific herring, as well as squid.

4.4.5 Dall's Porpoise

Dall's porpoises (*Phocoenoides dalli*) are widely distributed along the continental shelf (Hall 1979) as far north as 65° N (Buckland et al. 1993) and are abundant throughout the Gulf of Alaska (Calkins 1986). Dall's porpoises prefer water depths greater than 20 m deep (Hall 1979) and are commonly found in lower Cook Inlet (Calkins 1983). The only apparent gaps in their distribution in the Gulf of Alaska are in upper Cook Inlet and Icy Bay (Consiglieri and Braham 1982). The current estimate for the Alaska stock of Dall's porpoise is 83,400 (Hill and DeMaster 1999).

4.4.6 Harbor Seal

Harbor seals (*Phoca vitulina richardsi*) range from Baja California, north along the western coast of the United States, British Columbia, and Southeast Alaska, west through the Gulf of Alaska and the Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. Hill and DeMaster (2000) estimated 29,000 individuals in the Gulf of Alaska stock. The Gulf of Alaska populations around Kodiak and Tugidak Islands have grown since the early 1990s (Small 1996; Withrow and Loughlin 1997) but overall the stock numbers are in decline (Hill and DeMaster 2000).

Harbor seals inhabit estuarine and coastal waters, hauling out on rocks, reefs, beaches, and glacial ice flows. They are generally non-migratory, but move locally with the tides, weather, season, food availability, and reproduction activities (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969; Bigg

1981). Female harbor seals give birth to a single pup while hauled out on shore or on glacial ice flows. The mother and pup remain together until weaning occurs at 3 to 6 weeks (Bishop 1967; Bigg 1969). Little is known about breeding behavior in harbor seals. When molting, seals spend the majority of the time hauled out on shore, glacial ice, or other substrates. Harbor seals consume a variety of prey in estuarine and marine waters. Prey type varies regionally and seasonally in the Gulf of Alaska. Walleye pollock are the dominant prey in the eastern Gulf, and octopus is the dominant prey in the western Gulf.

No harbor seal haulout areas have been documented in the vicinity of the West Foreland. The closest harbor seal haulout area observed during a 1996 NMFS aerial survey is located just north of Big River, about 15 miles south of the West Foreland (Rehberg 2001).

4.4.7 Sea Otter

Sea otters (*Enhydra lutris*) occur in the coastal waters of the North Pacific Ocean and the southern Bering Sea. Typically, sea otters inhabit nearshore waters less than 35 m deep with sandy or rocky bottoms that support abundant populations of benthic invertebrates (Rotterman and Simon-Jackson 1988). In some areas, sea otters occur far from shore (e.g. further than 8 km in Prince William Sound); large aggregations are found more than 30 km north of Unimak Island (Rotterman pers. obs. from Rotterman and Simon-Jackson 1988). Canopy-forming kelp beds are used for resting and foraging although sea otters may also use areas void of kelp beds (Rotterman and Simon-Jackson 1988). Typical haulout habitat includes rocky points, sandy beaches, spits, islets, sandbars, rocks, and ice flows (Rotterman and Simon-Jackson 1988).

More than 90 percent of the world sea otter population is located in coastal Alaskan waters (Rotterman and Simon-Jackson, 1988). The south central Alaska stock of sea otters was estimated in 1998 to have a minimum population size of 20,948 (Gorbics et al. 1998). Sea otters consume an array of sessile and slow-moving benthic invertebrates including sea urchins, clams, mussels and crabs, octopus, squid, and epibenthic fishes (Rotterman and Simon-Jackson 1988).

In Cook Inlet, sea otters are primarily found in lower Cook Inlet (Calkins 1983). Population numbers are unknown, but it is thought that the Cook Inlet population is expanding. They have been observed in Tuxedni Bay on the west side and north of Anchor Point on the east side (Calkins 1983).

4.5 Marine Birds

This section describes seabirds, shorebirds, and waterbirds. Threatened and endangered species of marine and coastal birds are discussed in Section 6.

4.5.1 Seabirds

Lower Cook Inlet is one of the most productive areas for seabirds in Alaska. Approximately 27 species, comprised of an estimated 100,000 seabirds (USFWS 1992), occur in Cook Inlet, and about 18 species breed in the Inlet. Seabird breeding colonies occur along the coastline of the Gulf of Alaska and the lower Cook Inlet (DeGange and Sanger 1987, USFWS 1992). Approximately 71 colony sites have been recorded throughout Cook Inlet (USFWS 1992). The largest seabird colonies occur on Chisik and Duck Islands in lower Cook Inlet (USFWS 1992). Species breeding in lower Cook Inlet include glaucous-winged gulls, black-legged kittiwake, common murre, pigeon guillemot, horned and tufted puffins, parakeet auklet, and red-faced, double-crested, and pelagic cormorants.

Large concentrations of seabirds occur in Cook Inlet and the Gulf of Alaska during the spring when returning breeding species and migrants from breeding grounds in the southern hemisphere move into the area. The numbers remain high throughout the summer and decline in the fall as they begin to migrate to their wintering grounds (DeGange and Sanger 1987). Seabird numbers in Cook Inlet are lowest during the winter.

4.5.2 Shorebirds

Approximately 30 shorebird species occur as breeding birds and migrants in Cook Inlet. Although shorebirds nest in Cook Inlet, the most important areas for shorebird use in the region of the proposed project are the migratory stop-over areas in the northern Gulf of Alaska/lower Cook Inlet where birds stop to rest and feed. An important location for shorebirds during migration is western Cook Inlet (DeGange and Sanger 1987). These include the intertidal zones of Drift River, Iniskin Bay, and Chinitna Bay. Kachemak Bay in Lower Cook Inlet is also an important feeding and resting area for shorebirds during migration.

During spring migration, millions of shorebirds congregate at coastal intertidal mudflats to feed before continuing their northward migration. Most birds pass through the area between late April and mid May with the peak of the migration in early May. The two most common species are dunlin and western sandpiper. Turnover is high and individual birds probably only stop to feed and rest for a few days before continuing.

4.5.3 Waterbirds

Waterbirds (including loons) and waterfowl (swans, geese and ducks) occur as breeding birds and migrants in the Cook Inlet region. Nineteen species of waterbirds are common or abundant in the Cook Inlet/Shelikof Strait area, either as residents or migrants (MMS 1996a). Species include pintail, oldsquaw, common eider, common goldeneye, common merganser, red-breasted merganser, harlequin duck, greater scaup, mallard, gadwall, American widgeon, green-winged teal, arctic loon, common loon, red-throated loon, horned grebe, Canada goose, Pacific black brant, and emperor goose.

Waterbird density peaks in the region during the spring (April-May), when large numbers of waterbirds migrate through the area. The Cook Inlet area supports large populations (>200,000) of staging waterfowl on tidal flats (Susitna Flats, Portage Flats, Palmer Hay Flats, and Chickaloon Flats in the upper inlet and Bachatna Flats in the lower inlet), along river mouths, and in bays, particularly on the west side of the inlet (Redoubt, Trading, Tuxedni, and Kamishak bays). Areas of particularly high concentration are Tuxedni Bay, Kachemak Bay (especially sea and diving ducks), Kamishak Bay (sea ducks), Redoubt Bay (geese and ducks), and Iniskin-Iliamna Bay (diving ducks; Arneson 1980, MMS 1996a). The highest diversity and abundance of waterbirds are found in exposed inshore waters and various habitats associated with bays and lagoons, including open water, tidal mudflats, deltas, floodplains, and salt marshes (MMS 1984). Loons, grebes, and sea ducks are typically found on bays and exposed inshore waters; geese and dabbling ducks are primarily found on river floodplains and marshes; diving ducks mostly use bay waters (MMS 1984).

Waterbird density declines in summer as many birds leave the area. However, relatively high concentrations of sea ducks remain in Iniskin/Iliamna Bay and outer Kachemak Bay (MMS 1996a). During July and August, a molt migration of all three scoter species concentrates tens of thousands of birds in the coastal areas from Kotzebue Sound to Cook Inlet (MMS 1996b). Important staging areas used prior to fall migration are Kachemak Bay, Douglas River mudflats, Kenai River mudflats, Tuxedni Bay, Drift River, Chinitna Bay, Iliamna Bay, Ursus Cove, and other parts of lower Cook Inlet (Erikson 1976). On the west side of Shelikof Strait, Katmai Bay is important for several species of sea ducks, including white-winged scoter, greater scaup, Barrow's goldeneye, and harlequin ducks (Cahalane 1944).

In the fall, sea ducks depart the area, partially accounting for the overall decline in bird density relative to spring and summer densities (MMS 1996a). However, densities of dabbling duck and geese increase during this time, as migrants move into the area. In fact, 47 percent of all birds remaining in the coastal region are sea ducks (MMS 1996a). Four areas of Cook Inlet retain high bird densities: inner Kachemak Bay, southwestern Kamishak Bay, Tuxedni Bay, and northwestern Kachemak Bay; dabbling ducks, sea ducks, and gulls comprise 85 percent of all birds observed (MMS 1996a). Habitat use is similar to spring and summer patterns, with habitats associated with bays and lagoons being most heavily used (Arneson 1980).

Common winter residents along the southern Alaskan coast include oldsquaw, common and king eiders, harlequin ducks, and scoters. Over one million scoters winter in the Bering Sea, and several hundred thousand winter from the eastern Aleutians east to Kodiak Island, Cook Inlet, and Prince William Sound (Arneson 1980, Forsell and Gould 1981; Agler et al. 1995).

About 30 to 35 species of waterfowl regularly occur in the Cook Inlet area, including two species of swans (trumpeter and tundra swans), six species of geese, about 25 duck species, and six species of loons/grebes. The distribution of waterfowl within the region varies between the upper and lower inlet on a seasonal basis, and waterfowl are distributed differently between the eastern and western sides of Cook Inlet. Wintering populations of waterfowl are confined primarily to the lower inlet because of limited open water north of the Forelands.

Several waterfowl species occurring in the Cook Inlet area are of particular concern due to their limited breeding distribution, small population size, or use of critical habitats: trumpeter swan, Tule white-fronted goose, and snow goose.

Trumpeter swans arrive in Cook Inlet in early April and move to their breeding areas by late April (ADFG 1985). Nesting and brood rearing continue through late August and early September, and migration commences in late September and early October. Nesting swans are found on both sides of the central and upper inlet with major concentrations on the western side in Trading Bay, along the Kustatan River, and in Redoubt Bay. The 1990 census for trumpeter swans counted 1,661 swans in the Cook Inlet area, which is approximately 12 percent of the estimated total population in the state.

The Tule white-fronted goose breeds on the western side of Cook Inlet in Redoubt Bay (NCG 2001). They arrive in Cook Inlet in early April, begin nesting in May, and most have departed the area by late August. The nesting population in Cook Inlet is estimated at about 1,500 (total population estimated at 5,000) and the presence of nesting areas in the Redoubt Bay area was a primary reason for the creation of the Redoubt Bay State Critical Habitat Area.

Snow geese stage in large numbers on the Kenai River flats in mid-April (Rosenberg 1986). Total numbers of snow geese using the area vary annually, based on spring weather conditions, but counts have ranged between 2,000 and 15,000 birds each spring (Campbell and Rothe 1985, 1986; Rosenberg 1986). In addition to the Kenai River flats, snow geese stage in spring on the Kasilof River flats, the Susitna Flats, and Redoubt Bay (Campbell and Rothe 1986). An estimated 30,000 to 35,000 snow geese move through Cook Inlet in spring (Campbell and Rothe 1986) before they leave for their breeding grounds by early May.

5.0 Potential Impacts of Discharges on Marine Organisms

This section summarizes the potential effects of waste discharges from the Osprey Platform on marine organisms that may be present in the vicinity, and on humans. Because all drilling-related wastes will be reinjected rather than discharged to surface waters, this section focuses on non-drilling waste discharges such as sanitary waste, deck drainage, and domestic waste.

5.1 Toxicity of Discharges

Permitted waste streams from the Osprey Platform contain minimal chemical or biological toxicity, except as described below. Impacts of the sanitary waste discharge include the possible reduction in ambient dissolved oxygen concentrations in the receiving waters when sanitary waste is discharged (Tetra Tech 1994). The dissolved oxygen standard for aquatic life is usually 6 mg/L (Jones and Stokes 1989), while the ambient dissolved oxygen in the receiving waters of Cook Inlet is assumed to be higher than 8 mg/L (USEPA 1984). In an analysis of a worst case scenario, EPA (1984) concluded that the discharge of treated sewage effluent during offshore exploratory drilling should not significantly impact aquatic life when ambient dissolved oxygen concentrations are at least 1 mg/L above the dissolved oxygen standard for aquatic life of 6 mg/L. Because the sanitation device is an aerated system capable of providing a minimum of 2,100 cubic feet of air per pound of BOD, dissolved oxygen in the effluent is expected to meet this requirement when the system is properly operated in accordance with the operating manual (UIG 1998).

The wastewater will be chlorinated to remove fecal coliform (FC) bacteria. Effluent from the clarifier will flow through a chlorinator and into a 65-gallon chlorine detention tank where chlorine will dissipate for 30 minutes to an hour. Operated in accordance with the operating manual, the chlorine will reduce the fecal coliform bacteria to levels at or below the Alaska Water Quality Standard of 14 FC/100 ml.

The NPDES General Permit for Oil and Gas Production Platforms in Cook Inlet (USEPA 1999) requires a total residual chlorine concentration of at least 1 mg/L to ensure proper disinfection of the sanitary waste without causing harm to the aquatic life. In the case of the Osprey Platform sanitary waste, it appears that sodium sulfite will be used to dechlorinate the effluent in-line immediately prior to discharge (UIG 1998). The sodium sulfite reacts with free and residual chlorine instantaneously, consuming a small amount of alkalinity (1.38 mg of $CaCO_3$/ml chlorine consumed) (UIG 1998). The concentration of total residual chlorine in the final effluent is expected to be less than or equal to 2 ug/L (Amundsen 2000b). Thus the water quality standards for residual chlorine will be met at the end-of-pipe, causing no direct or indirect impacts on aquatic life.

Oil is the primary pollutant found in deck drainage, with concentrations estimated at 24 to 450 mg/L (USEPA 1996). Other potential contaminants include detergents and spilled drilling fluids. Contaminated deck drainage will be treated through an oil-water separator prior to discharge and will be required to meet state water quality standards. Therefore, no adverse impacts on water quality are predicted to result from discharge of deck drainage.

Domestic waste, which may contain kitchen solids and trace amounts of detergents, cleansers, and oil and gas, does not represent a significant discharge flow. Potential effects of domestic waste discharges are difficult to determine given the absence of analytical data, but are expected to be minimal.

Non-contact cooling water is not significantly different in composition than ambient seawater, except for an elevated temperature (estimated at 62° to 84°F; USEPA 1996). Forest Oil's permit application indicates that non-contact cooling water will be discharged at an average temperature of less than 60°F, with a maximum daily value of 70°F; therefore, no environmental impacts are predicted.

Boiler blowdown and fire control system test water are intermittent discharges that will be treated through an oil-water separator to remove oil and grease. No adverse impacts on water quality are predicted due to these discharges.

Excess cement slurry represents another intermittent discharge. The pH may be as high as 12, with temperatures up to 80°F and oil and grease up to 50 ppm (Amundsen 2000a). According to Forest Oil, excess cement slurry will not be treated prior to discharge. The draft NPDES permit for the Osprey Platform requires all discharges to have a pH between 6.5 and 8.5; this waste stream, if untreated, could exceed the draft effluent limits. Although the exact composition of the cement is not documented, given the small waste volume and intermittent nature of the discharge, it is not likely to represent a significant pollution source and is not predicted to result in adverse impacts.

In addition to meeting water quality standards or anticipated NPDES effluent limits, the wastes from the Osprey Platform will be discharged to a section of Cook Inlet which has been demonstrated to be a non-depositional, high-energy environment characterized by a cobble and sand bottom. Fast tidal currents and tremendous mixing produce rapid dispersion of the minimal concentrations of soluble and particulate pollutants. Brandsma (1999) determined that the high suspended solids discharge of drilling muds would be reduced more than two orders of magnitude within 100 meters under the least turbulent conditions, and three orders of magnitude under more turbulent conditions. It is expected that pollutants in the sanitary and other wastes will be dissipated to undetectable concentrations within a few feet of the discharge.

5.2 Human Health Impacts

Ingestion of organisms that have accumulated significant concentrations of heavy metals or other contaminants from drilling muds and produced water is the potential principal source of adverse human health effects caused by offshore oil and gas drilling operations. Because all drilling muds and cuttings will be reinjected rather than discharged, and because the permitted discharges from the Osprey Platform are only minimally toxic, no human health impacts are predicted.

5.3 Physical Effects of Discharge

The sanitary effluent is anticipated to contain average concentrations of TSS of less than 50 mg/L (Amundsen 2000b). This concentration is less than the daily maximum concentrations permitted for sanitary discharges from the oil and gas production platforms in Cook Inlet that operate under the NPDES General Permit (USEPA 1999) and the maximum daily limit in the proposed NPDES permit for the Osprey Platform.

Excess cement slurry may contain up to 200,000 mg/L of total suspended solids (daily maximum). However, because this waste stream is intermittent and the volume is small (about 4,200 gallons per event), it is not predicted to cause adverse impacts to marine organisms.

In addition, as described above, the wastes from the Osprey Platform will be discharged to a section of Cook Inlet which has been demonstrated to be a non-depositional, high-energy environment. Fast tidal currents and tremendous mixing produce rapid dispersion of the minimal concentrations of soluble and particulate pollutants.

Therefore, no physical effects of the discharge from the Osprey Platform are predicted.

5.4 Summary

Potential impacts of discharges from the Osprey Platform are summarized below.

5.4.1 Lower Trophic Level Organisms

Low concentrations of BOD and nutrients in the sanitary waste discharge could stimulate primary productivity and enhance zooplankton production. This effect is predicted to be negligible.

5.4.2 Fish

No adverse impacts on fish are expected due to the waste stream discharges from the Osprey Platform. Total residual chlorine (the only toxic contaminant of concern) will be discharged at concentrations that meet water quality criteria designed to protect both human health and aquatic life. Discharges will be diluted by the strong tidal flux of Cook Inlet. All of the wastewater discharges will comply with water quality standards for the state of Alaska (18 AAC 70). Therefore, impacts on fish from normal operations are not predicted to occur. Potential impacts on fish and essential fish habitat are discussed in more detail in the Essential Fish Habitat Assessment prepared for the Osprey Platform (SAIC 2001b, Appendix C).

5.4.3 Marine Birds

No adverse impacts on marine birds are expected due to the waste stream discharges from the Osprey Platform. Minor noise impacts generated during production operations could result in negligible to minor impacts on nesting birds in the Redoubt Bay Critical Habitat Area.

5.4.4 Marine Mammals

Discharges will be diluted by the strong tidal flux of Cook Inlet. Low concentrations of nutrients in the sanitary waste discharge may stimulate primary productivity and enhance zooplankton production, but these effects will probably be negligible. Total residual chlorine (the only toxic contaminant of concern) will be discharged at concentrations that meet water quality criteria designed to protect both human health and aquatic life. All of the wastewater discharges will comply with water quality standards for the state of Alaska (18 AAC 70). Therefore, impacts on marine mammals from wastewater discharges are not predicted to occur.

5.4.5 Human Health

Because all drilling muds and cuttings will be reinjected rather than discharged, and because the permitted discharges from the Osprey Platform are only minimally toxic, no human health impacts are predicted.

6.0 THREATENED AND ENDANGERED SPECIES

6.1 INTRODUCTION

Section 7 of the ESA requires federal agencies to conserve endangered and threatened species. It also requires all federal agencies to consult with NMFS or USFWS if they determine that any action they fund, authorize, or carry out may affect a listed species or designated critical habitat. The federal action under discussion in this document is the discharge of waste streams associated with oil and gas production operations at the Osprey Platform in Cook Inlet.

The following threatened and endangered species may be present near the proposed project:

- Steller's eider (*Polysticta stelleri*) – threatened
- Short-tailed albatross (*Phoebastria albatrus*) – endangered
- Fin whale (*Balenoptera physalus*) – endangered
- Humpback whale (*Megaptera novaeangliae*) – endangered
- Blue whale (*Balenoptera musculus*) – endangered
- Northern right whale (*Eubalaena glacialis*) – endangered
- Steller sea lion, western stock (*Eumetopias jubatus*) – endangered

In addition, the Beluga whale (*Delphinapterus leucas*) is listed as depleted under the Marine Mammal Protection Act and is also discussed in this section as a cetacean of special concern.

A biological assessment (BA) was prepared to assess the impacts of wastewater discharges from the Osprey Platform on threatened and endangered species of marine mammals or birds that may be present near the project area (SAIC 2000a); the BA provides additional details about the distribution, life history, diet, predators, population status, critical habitat, and factors affecting survival for each of the identified species.

6.2 ABUNDANCE AND DISTRIBUTION OF THREATENED AND ENDANGERED SPECIES

6.2.1 Birds

6.2.1.1 Steller's Eider

The USFWS listed the Alaskan breeding population of Steller's eiders (*Polysticta stelleri*) as threatened under the ESA on June 11, 1997. The Alaskan population of Steller's eiders nests along the western Arctic Coastal Plain in Alaska from approximately Point Lay east to Prudhoe Bay, with a known concentration in some years near Pt. Barrow, and in low numbers along the Yukon-Kuskokwim Delta (65 FR 49). Historically, nesting ranged from St. Lawrence Island and the Hooper Bay area north to Barrow (AOU 1997), and was rare east of Point Barrow. The current population trend for the Alaskan breeding population of Steller's eiders is unknown. USFWS estimates that hundreds or thousands of Steller's eiders may occur on the North Slope during the breeding season in early to mid-June.

In late June through August, Steller's eiders migrate southward along the northwest coast of Alaska (Gabrielson and Lincoln 1959) to the Alaska Peninsula, where they undergo a flightless molt for 10 to 14 days (65 FR 49). The geographic range of their wintering grounds remains unknown. However, Steller's eiders are thought to over-winter in relatively ice-free marine waters from Kodiak Island west to Unimak Island, Alaska (Palmer 1976). The timing of spring migration to the nesting grounds is dependent on weather conditions. Kessel (1989) noted that eiders typically move through the Bering Strait between mid-May and early June. Steller's eiders gather in staging areas before beginning their spring migration. These staging areas can contain thousands to tens of thousands of birds and are primarily located along the northern side of the Alaska Peninsula, including Port Heiden, Port Moller, Nelson Lagoon, and Izembek Lagoon (65 FR 49). Staging areas for the spring migration may also be used as winter habitat.

Steller's eiders feed on crustaceans, amphipods and mollusks (Cottom 1939, Peterson 1981). Eiders primarily feed near shore during the winter (65 FR 49). Raptors, gulls, jaegers, ravens, and foxes are their main predators, and where present, gulls are thought to harass eiders in winter feeding grounds, as well as in nesting areas (65 FR 49).

Little is known about the population dynamics of Steller's eiders. The reduction of eiders on historical breeding grounds suggests that Steller's eiders are either abandoning these historic nesting areas or that the population is declining. Currently, the causes of population declines in Steller's eiders are unknown, although possible causes include habitat loss or modification, increased predation in areas where human activities have artificially expanded predator populations by providing shelter and alternative food sources, lead poisoning on the Yukon-Kuskokwim Delta caused by the ingestion of lead shot while feeding, and food availability caused by changes in the Bering Sea ecosystem (USFWS 2000). In Siberia, possible causes of Steller's eider decline could also include habitat loss on the breeding grounds due to oil and gas exploration and unreported subsistence hunting (USFWS 2000).

In January 2001, the USFWS designated 7,330 square kilometers as critical habitat for Steller's eiders into five units (USFWS 2001). These units are located along the coastal areas of the Yukon-Kuskokwim Delta and along the Alaska Peninsula. Although Steller's eiders use areas in lower Cook Inlet, none were designated as critical in the final rule.

Steller's eiders may occur in Cook Inlet as occasional visitors during the winter months. Little information exists on the abundance and distribution of Steller's eiders in lower Cook Inlet. Steller's eiders have wintered in Kachemak Bay and further north along the eastern side of Cook Inlet (Balogh 1999). This area is considered wintering habitat for Steller's eiders. Balogh (1999) also indicated that no Steller's eiders have been observed on the western side of Cook Inlet, but that only a limited number of eider surveys have been conducted on the western side of Cook Inlet. The most recent observations of Steller's eiders in Cook Inlet reported approximately 1,000 Steller's eiders south of Ninilchik in 1999 (T. Antrobus, USFWS, pers. comm.). In 1997, 650 individuals were seen in the same area near Ninilchik. USFWS plans to conduct Steller's eiders surveys in the future to ascertain abundance and distribution of Steller's eiders in Cook Inlet.

6.2.1.2 Short-tailed Albatross

The short-tailed albatross (*Phoebastria albatrus*) is a pelagic seabird with long, relatively narrow wings adapted for soaring low over the water. The short-tailed albatross is the largest of the three species of Northern Pacific albatross, with an average wingspan of 84 inches and an average body length of 37 inches (Farrand 1983). It has a relatively long life span and may reach 40 years of age (Sherburne 1993). Breeding age is approximately 6 years, at which time they begin nesting every year. The short-tailed albatross is a monogamous, colonial nester and returns to nesting areas. The diet of short-tailed albatross includes squid, small fish, and crustaceans (DeGrange 1981).

Historically, the short-tailed albatross bred only in the western North Pacific (Sherburne 1993) on islands in Japan and Taiwan (63 FR 211). Today, there are only two known active breeding colonies, one on Torishima Island and one on Minami-Kojima Island, Japan. Short-tailed albatross usually arrive at breeding colonies in October and lay eggs by the end of the month. Females lay a single egg, and both parents incubate the eggs for 64-65 days. By late May, the chicks are almost full-grown, and the adults depart, leaving the chicks to fledge (63 FR 211). Avian and terrestrial predators of short-tailed albatross chicks include crows (*Corvus* sp.) and possibly introduced black rats and domestic cats on Torishima Island. Sharks may prey on albatross in the open ocean as well (63 FR 211).

The current world population of the short-tailed albatross is estimated to be 500 to 1,000 individuals. Currently, the short-tailed albatross is listed as endangered throughout its range under the 1973 Endangered Species Act (50 CFR 17). Alaska also lists the short-tailed albatross as endangered under the State of Alaska list of endangered species.

The short-tailed albatross was historically found year-round in the North Pacific from Siberia to the western coast of North America and the Bering Sea to the Hawaiian Islands (Roberson 1980). Documented critical habitat for the albatross occurs outside U.S. jurisdiction. However, important foraging habitat of the short-tailed albatross under U.S. jurisdiction includes the coastal regions of the North Pacific Ocean and Bering Sea during the non-breeding season and throughout the northwestern Hawaiian Islands during the breeding season. Annual observations of short-tailed albatross have been recorded in the Gulf of Alaska and the North Pacific since 1947. Although Cook Inlet is described as potential habitat for short-tailed albatross, none have been observed in the coastal waters of Cook Inlet since observations began (1947 through 1999; AKNHP 2000, IPHC 1999).

6.2.2 Marine Mammals

Endangered whales, such as the fin, humpback, blue, and northern right whale, could be present in lower Cook Inlet. Any observations of these species would most likely be near the entrance to Cook Inlet (Smith 1999). Most documentation of larger whales in Cook Inlet comes from historical records, mainly strandings (M. Eagleton, NMFS, pers. comm.). Historical data suggest that small numbers of humpback and fin whales have been observed in portions of lower Cook Inlet on occasion during the summer months and have been documented within one mile of shore (MMS 1996c). Humpback and fin whales are not found regularly above Kachemak Bay (Smith and Mahoney 1999). During the summer of 2000, humpbacks were observed around the entrance of Cook Inlet, near the Barren Islands. Blue and northern right whales are only accidental visitors in lower Cook Inlet.

6.2.2.1 *Fin Whale*

Fin whales (*Balenoptera physalus*) range from subtropical to arctic waters. The North Pacific fin whale population was estimated at 16,600 individuals in 1991 (NMFS 1991). Current abundance estimates are not available (Hill and DeMaster 2000). There have been no reports of incidental mortality of fin whales related to commercial fishing operations in the North Pacific during this decade. There also has been no reported harvest of fin whales by subsistence hunters in Alaska and Russia (Hill and DeMaster 2000). There are no published reports that indicate recovery of this stock has or is taking place (Braham 1992, Hill and DeMaster 2000).

The summer distribution of fin whales extends from central California to the Chukchi Sea. In Alaskan waters, some whales spend the summer feeding in the Gulf of Alaska, while others migrate farther north. Fin whales feed throughout the Bering and Chukchi Seas from June through October. Fin whales usually occur in high-relief areas where productivity is probably high (Brueggeman et al. 1988). Fin whales winter in the waters off the coast of California. Migration southward occurs from September through November. Northward migration begins in spring with migrating whales entering the Gulf of Alaska from early April to June (MMS 1996b). Most sightings of fin whales in southcentral Alaskan waters have been documented in the Shelikof Strait, near Kodiak Island and lower Prince William Sound (Montgomery Watson 1993). Authenticated sightings of fin whales are rare in Cook Inlet as most documentation has been based on carcass sightings (M. Eagleton, NMFS, pers. comm.). No critical habitat in Alaska has been designated for this species.

Fin whales usually breed and calve in the warmer waters of their winter range. Breeding can occur in any season, but the peak occurs between November and February (Tomilin 1967, Ohsumi 1958). Fin whales are opportunistic feeders, taking euphausiids, copepods, fish and squid (Lowry et al. 1982).

6.2.2.2 *Humpback Whale*

Humpback whales (*Megaptera novaeangliac*) in the North Pacific are seasonal migrants that feed in the cool, coastal waters of the western United States, western Canada, and the Russian far east (NMFS 1991). The Western North Pacific stock of humpback whales spends winter and spring in waters off Japan and migrates to the Bering Sea, Chukchi Sea, and Aleutian Islands in the summer and fall (Berzin and Rovnin 1966, Nishiwaki 1966, Darling 1991). The current estimate of the Western North Pacific humpback whale stock (the stock most likely utilizing the Cook Inlet area) is 394 animals (Calambokidis et al. 1997). Sightings of humpbacks are rare in Cook Inlet, although they are common around the Barren Islands, south of Cook Inlet in the summer months. No critical habitat in Alaska has been designated for this species.

Breeding and calving occur on the wintering grounds near Japan. Most births occur between January and March (Johnson and Wolman 1984). Humpbacks feed on euphausiids, amphipods, mysids, and small fish, such as Pacific herring, capelin, anchovies, sardines, cod, and sand lance (Wolman 1978, Wing and Krieger 1983). Humpback whales are thought to feed mainly during the summer months (Wolman 1978).

Reliable information on the trends in abundance for the Western North Pacific humpback whale is not available. No commercial fishery related mortalities have been observed during 1990 to 1997 monitoring. The annual estimated mortality rate due to commercial fisheries is 0.2 whales per year. However, this is considered a minimum rate since no data are available from Japanese, Russian, or international waters (Hill and DeMaster 2000).

6.2.2.3 Blue Whale

Summering blue whales (*Balenoptera musculus*) from the North Pacific stock are present in waters from California to Alaska. Blue whales occur in a narrow area just south of the Aleutian Islands from 160° W to 175° W (Berzin and Rovnin 1966, Rice 1974). The species is also distributed in an area north of 50° N latitude extending from southeastern Kodiak Island across the Gulf of Alaska and from southeast Alaska to Vancouver Island (Berzin and Rovnin 1966). Whaling records indicate that large concentrations of this species once occurred in the northern part of the Gulf of Alaska southwest of Prince William Sound in the Port Banks area (Nishiwaki 1966). However, recent sightings in Alaskan waters have been scarce (MMS 1996b). No critical habitat in Alaska has been designated for this species.

Blue whales usually begin migrating south out of the Gulf of Alaska by September (Berzin and Rovnin 1966). Migration routes are thought to be along the western coast of North America. The North Pacific blue whale population winters from the open waters of the mid-temperate Pacific south to at least 20° N (MMS 1996b). The northward spring migration begins in April or May, with whales traveling in the eastern Pacific (Berzin and Rovnin 1966). Mating and calving are thought to take place over a five-month period during the winter (Mizroch et al. 1984). Blue whales feed principally on krill, small euphausiid crustaceans, primarily in their summer range (Nemoto 1959, Berzin and Rovnin 1966).

There is relatively little information about the abundance or mortality of blue whales since hunting ceased in 1967 (MMS 1996b). The most recent estimate of the North Pacific blue whale population was approximately 1,700 individuals (Barlow and Gerrodette 1996). There is no evidence that the blue whale population is recovering (MMS 1996b, Mizroch et al. 1984).

6.2.2.4 Northern Right Whale

Northern right whales (*Eubalaena glacialis*) can grow up to 50 feet in length. These large, slow swimming whales tend to congregate in coastal waters. Little is known about the life history of the right whale. No calving grounds have been found in the eastern North Pacific (Scarff 1986). Consequently, right whales are thought to calve in southern coastal waters of their distribution during the winter months (Scarff 1986). Scarff (1986) hypothesized that right whales summering in the eastern North Pacific mate, calve, and overwinter in the mid-Pacific or Western North Pacific. The migration patterns of the North Pacific stock are also unknown. During summer, it is assumed that right whales migrate to their summer feeding grounds in the higher latitudes of their range. In winter, they migrate to the more temperate waters (Braham and Rice 1984). The location and type of critical habitat for right whales is unknown due to the rarity of this species. Right whales feed primarily on zooplankton, copepods and euphausiids (MMS 1996b).

Whaling records indicate that right whales in the North Pacific range across the entire North Pacific north of 35° N. Commercial whalers hunted right whales nearly to extinction during the 1800s. From 1958 to 1982, there were only 32 to 36 sightings of right whales in the central North Pacific and Bering Seas (Braham 1986). In the eastern North Pacific south of 50° N, only 29 reliable sightings were recorded between 1900 and 1994 (Scarff 1986, Scarff 1991, Carretta et al. 1994). Wada (1973) estimated a total population of 100 to 200 in the North Pacific. In 1996, a right whale was sighted off Maui (Hill and DeMaster 2000) and a group of 3 to 4 right whales was sighted in Bristol Bay. In 1997, a group of 5 to 9 individuals was seen in approximately the same Bristol Bay location (Hill and DeMaster 2000). A reliable current estimate of abundance for the North Pacific right whale stock is not available (Hill and DeMaster 2000). Although they may travel through the Gulf of Alaska, it is highly unlikely that right whales use Cook Inlet.

6.2.2.5 Steller Sea Lion, Western Stock

Steller sea lions (*Eumetopias jubatus*) range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984). The centers of abundance and distribution are located in the Gulf of Alaska and the Aleutian Islands. At sea, Steller sea lions commonly occur near the 200-m depth contour, but are seen from near shore to well beyond the continental shelf (Kajimura and Loughlin 1988).

In 1997, NMFS designated the Western stock of Steller sea lions as endangered under the ESA (62 FR 30772). Aerial and ground-based surveys suggest a minimum population size of approximately 39,000 Steller sea lions in the western U.S. in 1998 (Sease and Loughlin 1999). The first reported trend counts of Steller sea lions in Alaska indicated at least 140,000 sea lions in the Gulf of Alaska and Aleutian Islands (Kenyon and Rice 1961, Mathisen and Lopp 1963). Counts in 1976 and 1979 estimated 110,000 sea lions and suggested a major population decrease in the Aleutian Islands beginning in the mid 1970s (Braham et al. 1980). The largest declines occurred in the eastern Aleutian Islands and western Gulf of Alaska, but declines have also occurred in the central Gulf of Alaska and the central Aleutian Islands. Counts at trend sites from 1990 to 1996 indicate a 27 percent decline. Counts at trend sites in 1998 suggest a further 7.8 percent decline since 1996 (Hill and DeMaster 2000).

Adult female Steller sea lions usually breed annually (Pitcher and Calkins 1981). Females reach sexual maturity between three and six years of age and can produce young into their early 20s (Mathisen et al. 1962, Pitcher and Calkins 1981). Females produce a single pup each year. Pups are born from late May to early July. Young are usually weaned by the end of their first year but may continue to nurse until age three (Lowry et al. 1982). Males reach sexual maturity between three and seven years of age.

Steller sea lions eat a variety of fish and invertebrates. Harbor seals, spotted seals, bearded seals, ringed seals, fur seals, California sea lions and sea otters are also occasionally eaten (Tikhimirov 1959, Gentry and Johnson 1981, Pitcher 1981, Pitcher and Fay 1982, Byrnes and Hood 1994). Walleye pollock is the principal prey in most areas of the Gulf of Alaska and the Bering Sea (NMFS 1995). In the Aleutian Islands, Atka mackerel was the most common prey followed by walleye pollock and Pacific salmon (NMFS 1995).

Steller sea lions use specific locations along the coast of Alaska as rookeries and haul-out sites. All sea lion haul-out sites are considered critical habitat because of their limited numbers and high-density use. Alteration of these areas through disturbance or habitat destruction could have a significant impact on the use of these sites by sea lions. Although no rookeries or haul-out sites have been identified in the Cook Inlet area, Steller sea lions may range and forage throughout Cook Inlet during salmon runs (Smith 1999). For example, one male Steller sea lion was observed at the mouth of the Susitna River (M. Eagleton, NMFS, pers. comm.). However, only a small number of animals are present at any particular time and they would not be present in any significant concentrations in Cook Inlet. The nearest reported Steller sea lion rookery is the Sugarloaf Islands rookery located in the Barren Islands (58° 53.0" N, 152° 2.0" W) (NMFS 2000c). The nearest major Steller sea lion haul-out is located on Ushagat Island (58° 55.0" N, 152° 22.0" W), also in the Barren Islands.

Declines in juvenile survival appear to be an important proximate cause of the decline in the Alaskan population of Steller sea lions from the early 1980s to the present. Since 1985, researchers have noted a reduced abundance of juvenile animals on declining rookeries (Merrick et al. 1987; NMFS and ADFG unpublished data cited in NMFS 1995). York (1994) suggested a 10 percent to 20 percent decrease in juvenile (ages 0 to 4) survival in the Kodiak Island population, and Pascual and Adkinson (1994) concluded that juvenile survival could have declined as much as 30 percent to 60 percent. Despite the apparent declines in juvenile survival, the large-scale declines which occurred in the Aleutian Islands during the 1970s and from 1985 to 1989 are too large to be caused solely by changes in juvenile survival. NMFS (1995) suggests that acute declines in adult survival were overlaid on an ongoing, chronic decline in juvenile survival.

Steller sea lion pup mortality occurs from drowning, starvation caused by separation from the mother, crushing by larger animals, disease, predation, and biting by females other than the mother (Orr and Poulter 1967; Edie 1977). Juvenile and adult Steller sea lions are eaten by sharks and killer whales, but the rates and significance of this predation is not known.

A number of factors do not appear to be important in the decline of Steller sea lion populations, including the effects of toxic materials, parasites, entanglement, commercial and subsistence harvest, disturbance, and predation (NMFS 1992). Factors that remain under consideration are shooting, incidental take in fisheries, disease, and changes in the quantity or quality of the prey base.

6.2.2.6 Cetacean of Special Concern -- Beluga Whale

Beluga whales (*Delphinapterus leucas*) are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980). The Cook Inlet stock of beluga whales was listed as depleted under the MMPA on May 31, 2000 (65 FR 105; 50 CFR 216.15). After the completion of the status review, NMFS denied a petition to list the Cook Inlet stock of belugas as endangered (65 FR 121).

Klinkhart (1966) first surveyed Cook Inlet beluga whales in 1963 and 1964, at which time the minimum population was estimated to be between 300 and 400 whales. In 1979, 1982, and 1983, Calkins performed extensive aerial surveys of the inlet and reported sighting as many as 479 belugas in 1979 (Morris 1992) and estimated the stock at 1,300 animals. However, these surveys were not designed to estimate abundance throughout the entire Cook Inlet. Most past surveys have concentrated only on the upper inlet when belugas are congregated at the mouths of rivers for calving and feeding (Morris 1992). However, information on breeding and reproduction specific to the Cook Inlet belugas is generally lacking.

NMFS initiated population surveys in 1993 to estimate the abundance of Cook Inlet belugas. Surveys between 1994 and 1999 produced abundance estimates of 653, 491, 594, 440, 347, and 357 whales, respectively (65 FR 105). These numbers indicated more than a 40 percent decline in population size over the last 6 years. Beluga distribution data also suggest a reduction in offshore sightings in both upper and lower Cook Inlet during the summer (Rugh et al. 2000).

During the 2000 Cook Inlet beluga whale surveys, 184 individuals were sighted (Rugh et al. 2000). This was the lowest median raw count (the number of whales actually observed and not corrected for missed whales) of belugas since NMFS initiated the surveys in 1993. However, correcting for whales missed results in a population estimate of 435 (O'Harra 2001).

Beluga whales occupy different parts of Cook Inlet throughout the year (Sheldon 1993). Concentrations occur nearshore in the northwestern upper inlet from April through June (Calkins 1989). The largest counts of belugas have occurred during May and June (Morris 1992), particularly between the West Foreland and Knik Arm (Sheldon 1993). Withrow et al. (1994) report large aggregations of up to 260 near the mouths of the rivers. By August, beluga concentrations disperse along the coastline of the upper and central inlet. Groups of less than 10 animals distributed along the coastline north of Kalgin Island have been reported in late September (Withrow et al. 1994). With the return of ice in late fall, the population likely moves into the lower inlet (Sheldon 1993), although it appears that some belugas remain in the upper Cook Inlet during the winter if conditions are appropriate (NMFS 2000a). The tracking of two satellite-tagged belugas from September 2000 to January 2001 indicates that these whales were spending a portion of the winter in upper Cook Inlet (NMFS 2000a).

Current data on mortality and serious injury from all fishery related activities are not available for the Cook Inlet stock of beluga whales. In Cook Inlet, belugas may contact purse seines, drift gillnets, and set gillnets. However, it is currently thought that commercial fisheries in Cook Inlet have little, if any, interaction with belugas. Between 1981 and 1983 in Cook Inlet, an estimated 3 to 6 belugas were killed per year from interactions with fishing gear in Cook Inlet (Burns and Seaman 1986). Self-reports of beluga mortalities from commercial fisherman throughout the 1990s were considered incomplete and unreliable. Since 1999, observers have been used to document beluga mortalities from the Cook Inlet gillnet fisheries. No beluga mortalities or interactions with fisheries have been observed during the present observer program (Hill and DeMaster 2000).

The decline of Cook Inlet belugas has been primarily attributed to subsistence harvest by Alaska Natives (NMFS 2000b). Mean annual subsistence take of beluga whales from the Cook Inlet stock averaged 87 whales between 1993 and 1997. Currently, there is a moratorium on harvesting Cook Inlet belugas. Future harvest levels have yet to be determined. Because of the extremely low population numbers, cumulative harvest over a number of years would likely affect the recovery rate of the Cook Inlet population. During 1998, local Alaska Native organizations and NMFS began to formalize a specific agreement for management of the Cook Inlet beluga stock, and it was finalized in 2000.

Beluga whales feed seasonally on a variety of fishes, shrimps, squid, and octopus (Burns et al., 1985). Fish species that Cook Inlet belugas feed on during the summer include salmon, herring, eulachon, capelin, smelt, and arctic cod (Calkins 1989). Pacific tomcod may be an important food source for Cook Inlet belugas in autumn and winter when salmon and eulachon are not available (Calkins 1989).

Large groups of belugas congregate at river mouths in the upper drainages of Cook Inlet to feed on migrating prey species, such as the eulachon and salmon (Morris 1992). Belugas generally feed in the upper 30 feet of the water column (Morris 1992), with most feeding dives thought to be between depths of 20 and 100 feet and to last 2 to 5 minutes (ADFG 1999).

The killer whale is the beluga whale's only natural predator. Killer whales are common visitors to Cook Inlet and have been known to pursue belugas in Cook Inlet (M. Eagleton, NMFS, pers. comm.).

6.3 Effects of Permitted Discharges on Threatened and Endangered Species

This section summarizes potential impacts on threatened and endangered species from Osprey Platform discharges, including sanitary waste, deck drainage, domestic waste, non-contact cooling water, excess cement slurry, fire control system test water, and boiler blowdown. The discharges are described in Section 2.2. Potential impacts of wastewater discharges on threatened and endangered species were evaluated as part of a Biological Assessment (BA) prepared for the Osprey Platform (SAIC 2000a) in compliance with Section 7 of the ESA. Conclusions of the BA are summarized below.

6.3.1 Steller's Eider

Steller's eiders are only occasional winter visitors to the western side of Cook Inlet. Wastewater discharges associated with the Osprey Platform are not likely to directly or indirectly affect Steller's eiders, nor is the action likely to adversely affect or jeopardize the threatened Alaska nesting populations or its critical habitat. The actions are also not likely to have incremental effects resulting in a cumulative impact to Steller's eiders or their proposed critical habitat.

6.3.2 Short-tailed Albatross

The Short-tailed albatross has not been observed in the coastal waters of Cook Inlet since prior to 1947. Therefore, wastewater discharges associated with the Osprey Platform will not likely have any direct, indirect, or cumulative impacts on the Short-tailed albatross. Neither will it jeopardize the recovery of this species.

6.3.3 Fin, Humpback, Blue, and Northern Right Whales

Humpback and fin whales are not found regularly above Kachemak Bay; blue and northern right whales would be only accidental visitors to lower Cook Inlet. Discharges from the Osprey Platform are not likely to directly or indirectly impact any of the four endangered whale species, nor is the action likely to adversely affect or jeopardize the endangered Alaska populations or their critical habitat. The proposed project also will not have incremental effects resulting in a cumulative effects to these species.

6.3.4 Steller Sea Lion

A small number of Steller sea lions may occur near the project area. Discharges from the Osprey Platform will be diluted by the strong tidal flux of Cook Inlet, however, and any disturbance of Stellar sea lions would be very short-term and unlikely to adversely affect the animals. Wastewater discharges associated with the Osprey Platform are not likely to directly or indirectly affect Steller sea lions, nor is the action likely to adversely affect or jeopardize the threatened Alaska population or its critical habitat. The actions are also not likely to have incremental effects resulting in a cumulative impact to Steller sea lions or their proposed critical habitat.

6.3.5 Cetacean of Special Concern – Beluga Whale

Wastewater discharges from the Osprey Platform will occur outside areas in Cook Inlet where large concentrations of belugas are present during the summer (NMFS 2000a). Although the platform will be operated year-round, the West Foreland is not heavily used by beluga whales (Smith and Mahoney 1999). The volume and concentration of pollutants in the discharges from the platform are minimal; once released, the discharges will be rapidly dispersed by the strong tidal fluxes in Cook Inlet. Therefore, it is unlikely that wastewater discharges would directly or indirectly affect Cook Inlet belugas or their critical habitat. The proposed actions are also not likely to have incremental effects resulting in a cumulative impact to this species.

6.4 SUMMARY

Wastewater discharges from the Osprey Platform are minimal, and their contribution to the cumulative loading of contaminants in Cook Inlet are predicted to be negligible. Based on the Cook Inlet tidal flux, the anticipated volume of wastewater discharge, and the Osprey Platform's contribution to the cumulative loading of waste discharges in Cook Inlet, the BA concluded that wastewater discharges from the Osprey Platform will be rapidly diluted and will likely have no adverse effect on the marine mammal and bird species described above or to critical habitat associated with these species.

7.0 COMMERCIAL, RECREATIONAL, AND SUBSISTENCE HARVEST

This section describes the commercial, recreational, and subsistence fisheries in Cook Inlet, and the potential impact of discharges from production drilling operations at the Osprey Platform.

7.1 COMMERCIAL HARVESTS

Commercial fishing has long been a major economic sector for the Cook Inlet area. The Alaska Department of Fish and Game (ADF&G) is responsible for management of the commercial fisheries in Alaska. ADF&G divide the inlet into the Central and Northern District for purposes of fisheries management. The proposed project straddles the boundary between the Northern and Central District, which is a line that extends from West Foreland to Boulder Point.

Commercial fishing operations in the Northern District are limited to set net fishing from shore. Set net fishing sites are located along most of the upper inlet from the West Foreland to Pt. Mackenzie on the west side of the inlet and from the East Foreland to Point Possession on the east side of the inlet. Openings for set netting are typically on specific days, intermittently occurring between early June and early September.

There are two known areas of set net fishing activities near the tip of the West Foreland. One site is located at Kustatan and the other is located at the southeasternmost tip of the West Foreland. The Kustatan site is registered with the Alaska Department of Natural Resources, while the other is not.

All five Pacific salmon species are caught in the Northern District set net fishery. Pink salmon during the even-year runs are the most abundant numerically, although they have very little value to the commercial fishery. Sockeye salmon are the second most frequently caught salmon and they account for over 50 percent of the ex-vessel value of the fishery.

In general, salmon catches by the commercial fisheries have remained relatively stable (SAIC 2000b). Price of the fish have dropped dramatically over the past 10 years and the industry in the Northern District, which had a value of about $3 million to $4 million in the late 1980s, is now valued at a little over $1 million annually.

7.2 RECREATIONAL FISHERY

The drainages of the upper inlet support some of the most intense sport fisheries in Alaska because of their proximity to Anchorage. This area consistently supports over 20 percent of the total annual sport fishing effort expended in Alaska (Mills 1992). Sport fishing in the northern and central inlet has been increasing steadily, with almost 500,000 angler days expended on northern inlet streams (Mills 1992, NCG 2001). The Kustatan River located immediately southwest of the West Foreland supports a relatively active sports fishery for chinook, sockeye, pink and coho salmon and for Dolly Varden (ADFG 1994); access to the river is primarily by small fixed wing aircraft. The majority of sport fishing occurs during the summer and fall months.

A recreational fishery in central Cook Inlet targets Pacific halibut. The Sport Fish Division of the Alaska Department of Fish and Game estimates that 75,709 halibut were caught by sport fishermen in central Cook Inlet between May 1 and July 31, 1995 (McKinley 1996).

7.3 SUBSISTENCE HARVESTS

Subsistence is defined by the Alaska National Interest Lands Conservation Act (ANILCA). Section 803 defines subsistence as:

> "...the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-eatable by-products of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade."

This section discusses practices by households that may be altered or affected by waste discharges from the Osprey Platform. However, the use areas and practices differ as greatly as the size and socioeconomic character of each area's populations. Local subsistence values are critical in that households feel their subsistence activities are important, necessary, and satisfying with their overall cultural context. While many animals and plants may be taken for subsistence, it is the most common practices that are recorded and reported, especially for the west side of the inlet.

Subsistence tends to occur in areas of close proximity to settlements. These practices also tend to occur at locations where there is easy access and where the biomass concentration is high. The increasing population on the east side of the inlet has created limitations to subsistence practices, while on the west side of the inlet, many traditional practices continue with a greater diversity of species. Some subsistence practices are frequently conducted in conjunction with recreation (and should not be confused with recreational activities) on both sides of the inlet.

Tyonek is a critical subsistence focus area due to its proximity to the project. The following discussions also center on marine-related activities. Although terrestrial subsistence activities do occur, they are distant from and highly unlikely to be impacted by the proposed development.

7.3.1 Anadromous Fish

Many fish are harvested through subsistence and related activities, although salmon are the most important. The ADF&G has a number of established subsistence and educational fisheries in Cook Inlet. Within the upper inlet, these include the Tyonek subsistence salmon fishery, the Native Village of Eklutna educational fishery, and the Knik Tribal Council educational fishery. These are discussed in the following paragraphs. There are several other subsistence and educational fisheries in the inlet below the Forelands; however, they are not addressed because it is unlikely that fish potentially involved in these fisheries would encounter the project area.

The subsistence fishery in the Tyonek area was created by court order in 1980. It was originally open only to those individuals living in the Village of Tyonek but has subsequently been changed to allow any Alaskan to participate. Fishing is allowed only in the Tyonek Subdistrict of the

Northern District. Only one permit is allowed per household and each permit holder is allowed a single ten-fathom gillnet having a mesh size no greater than 6 inches. Fishing is allowed on specific days between May 15 and June 15, or until 4,200 Chinook salmon are taken. The permit allows 25 salmon per permit holder and 10 salmon for each additional household member. Chinook salmon harvests have ranged form 797 in 1990 to 2,750 in 1983.

In 1993, the ADF&G issued permits to Alaska residents accompanied by an Eklutna Native village member or a Knik Tribal Council Member to participate in this fishery. The permit allows each village to operate a single 10-fathom set gillnet having a mesh size no greater than 6 inches. The net may be set in Knik Arm adjacent to the village or in those waters within one mile from mean high water in an area from Goose Bay Creek north to Fish Creek. Total catch was 200 and 275 salmon for the Eklutna and Knik fisheries, respectively, in 1996 (NCG 2001).

7.3.2 Other Fish

Eulachon (hooligan) are taken in set nets and by dip netting along the west side of the upper inlet from Tyonek south to Shirleyville for both subsistence and personal use. About a quarter of all Tyonek households seek hooligan (Fall et al. 1984). Other species of fish are taken in small numbers. Rainbow trout are occasionally taken. Dolly Varden char are incidental to the taking of salmon in nets but are also taken in fresh water. About 15 percent of Tyonek households seek freshwater species (Fall et al. 1984).

7.3.3 Shellfish

Approximately 18 percent of the Tyonek households collect shellfish as subsistence activities. Cockles and razor clams are both taken in the lower inlet from between Drift River and Tuxedni Bay. These areas are well out of the project area.

7.3.4 Marine Mammals

Two types of marine mammals are taken. Beluga whales are actively sought and harbor seals are usually taken incidentally. Only 11 percent of Tyonek households attempt to take marine mammals and the actual contribution to the Tyonek diet is low (Fall et al. 1984).

Beluga whales are taken for subsistence, especially by urban Alaska Natives from the greater Anchorage area. The focus of the harvest is at the mouth of the Susitna River (Fall 1993). Some have also been shot just outside the mouth of the Kenai River, as local firearms ordinances limit the discharge of guns within the city limits.

Prior subsistence harvests of belugas have resulted in a substantial decline in their population to the extent that they are currently listed as a depleted species under the Marine Mammal Protection Act. Under the depleted status, future subsistence take is proposed to be limited to two belugas annually (NMFS 2000a).

Harbor seals are normally taken only incidentally. They may be harvested while in pursuit of other subsistence interests or in transit to subsistence areas. Most frequently, harbor seals are taken around set net sites during salmon season.

7.3.5 Birds

Waterfowl, including many species of ducks and geese, are taken around the Trading Bay area. As many as 47 percent of the Tyonek households seek waterfowl in the nearshore marshes (Fall et al. 1984, Fall 1993).

7.4 Effects of Waste Stream Discharges on Harvest Quantity and Quality

The production drilling operations at the Osprey Platform are predicted to have insignificant impacts on the quantity or quality of the commercial, recreational, or subsistence harvests in Cook Inlet, based on the relatively limited volume of wastes discharged, the limited areal extent of pollutant discharges, the rapid dilution of discharges by the strong tidal flux of Cook Inlet, and the mobility of harvested species.

8.0 COASTAL ZONE MANAGEMENT AND SPECIAL AQUATIC SITES

8.1 COASTAL ZONE MANAGEMENT

8.1.1 Requirements of the Coastal Zone Management Act

The Coastal Zone Management Act requires that states make consistency determinations for any federally-licensed or permitted activity affecting the coastal zone of a state with an approved Coastal Zone Management Program (CZMP) (16 USC Sec. 1456(c)(A) Subpart D). Under the Act, applicants for federal licenses and permits must submit a certification that the proposed activity complies with the state's approved CZMP. The state then has the responsibility to either concur with or object to the consistency determination.

Consistency certifications are required to include the following information (15 CFR 930.58):

- A detailed description of the proposed activity and its associated facilities
- A brief assessment relating the probable coastal zone effects of the proposal and its associated facilities to relevant elements of the CZMP
- A brief set of findings indicating that the proposed activity, its associated facilities, and their effects are consistent with relevant provisions of the CZMP
- Any other information required by the state.

8.1.2 Relevance of Requirements

Consistency determinations are required if a federally-licensed or permitted activity "affects" the coastal zone. Waste stream discharges during production oil and gas drilling activities at the Osprey Platform in Cook Inlet will occur in state waters. Therefore, a consistency assessment is required.

8.1.3 Status of Coastal Zone Management Planning

The Alaskan Coastal Management Program (ACMP) was approved by the U.S. Department of Commerce in 1979. The state coastal management policies and guidelines included in the ACMP are intended to be refined by local districts preparing district Coastal Management Plans (CMPs). Completed district CMPs must be approved by the Alaska Coastal Policy Council. District CMPs must then be approved by the Department of Commerce, either as routine program implementation or as an amendment to the ACMP. Once approved by the Department of Commerce, district CMPs become the basis for federal consistency determinations.

The proposed project falls under the provisions of the Kenai Peninsula Borough (KPB) CMP. The KPB CMP (KPB 1990) includes issues, goals, objectives, and policies directly related to energy and industrial development. These policies are implemented through local review of state and federal permit applications and through borough land use planning and zoning regulations.

8.1.4 Relevant Policies

Policies of the ACMP that are potentially relevant to waste discharges from offshore oil and gas exploration are set forth in the ACMP standards (6 AAC Chapter 80). Article 2 sets forth standards related to a number of uses and activities in the Alaska coastal zone. It sets forth the following policy for subsistence uses: "Districts and state agencies shall recognize and assure opportunities for subsistence usage of coastal areas and resources." This policy is designed to be fully implemented in district CMPs.

Article 3 sets forth standards for resources and habitats that are relevant to waste discharges from oil and gas exploration. Of the habitat types it identifies, the following habitats could be affected by these discharges: offshore areas, estuaries, wetlands and tideflats, and exposed high energy coasts. The fundamental standard for management of these habitats is that they "must be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources" (6 AAC 80.130[b]).

The Kenai Peninsula Borough CMP was federally approved by the Department of Commerce in June 1990 and includes state coastal waters in upper Cook Inlet. The Kenai Peninsula Borough CMP incorporates the state policies and adds the following enforceable policies:

- To the extent feasible and prudent, all temporary and permanent developments, structures, and facilities in marine and estuarine waters shall be sited, constructed, and operated in a manner that does not create a hazard or obstruction to commercial fishing operations (KPB CMP Enforceable Policy 2.3).
- Within marine and estuarine waters of the coastal area, operators of activities relating to oil, gas, and mining exploration and production, shall provide timely written notification to a list of fishing organizations maintained by the Kenai Peninsula Borough to apprise commercial fishing interests of the schedule and location of development activities prior to initiation of the project. This notice shall include a schedule of activities and a map or description of any potential conflicts or physical obstructions which may impact or preclude commercial fishing opportunities or damage/contaminate fishing gear including but not limited to subsea pipelines, subsea wellhead structures, and modifications to the natural shoreline topography or sea-bottom profile (e.g., causeways, artificial islands, dredge spoil disposal sites) (KPB CMP Enforceable Policy 2.3).
- Projects that require dredging or filling in streams, rivers, lakes, wetlands, or saltwater areas including tideflats, will be located, designed, constructed, and maintained in a manner so as to: a. avoid significant impacts to important fish and wildlife habitat; b. avoid significant interference with fish migration, spawning, and rearing as well as other important life history phases of wildlife; c. limit areas of direct disturbance to as small an area as possible; d. minimize the amount of waterborne sediment traveling away from the dredge or fill site; and e. maintain circulation and drainage patterns in the area of the fill (KPB CMP Enforceable Policy 2.4).
- All land and water use activities shall be planned and conducted to mitigate potential adverse impacts on fish and wildlife populations, habitats, and harvest activities. Mitigation shall include the following sequential steps: a. Avoid the loss of natural fish and wildlife populations, habitat, and harvest activities; b. When the loss cannot be avoided, minimize loss by incorporating measures to reduce the amount or degree of loss; c. When the loss cannot be avoided or minimized, restore or rehabilitate the resource that was lost or disturbed to its pre-disturbance condition, to the extent feasible and prudent; or d. When loss or damage is substantial and irreversible and the above objectives cannot be achieved, compensation for the resource and/or harvest loss shall be considered. In the case of loss of habitat production potential, enhancement of other habitats shall be considered as an alternative means of compensation. In general, compensation with similar habitats in the same locality is preferable to compensation with other types of habitat or habitats located elsewhere (KPB CMP Enforceable Policy 2.6).
- Development and resource extraction activities shall be sited and conducted to minimize accelerated shoreline erosion or adverse impacts to shoreline processes. Developers shall retain existing vegetative cover in

erosion-prone areas to the greatest extent feasible and prudent. In cases where development or other activities lead to removal of vegetation, erosion shall be prevented or, if it occurs, shall be remedied through revegetation or by other appropriate measures (KPB CMP Enforceable Policy 3.3).

- Commercial/Industrial operations shall use necessary measures to prevent drilling wastes, oil spills, and other toxic or hazardous materials from contaminating surface and groundwater (KPB CMP Enforceable Policy 5.2).
- Any industrial water withdrawal shall comply with the requirements of AS 46.15 and may require that aquifer testing of the production well(s) and monitoring of nearby public or private wells be conducted. Results of testing shall be submitted to the Kenai Peninsula Borough and the Alaska Department of Natural Resources; these results should demonstrate what effects the withdrawal of water necessary to serve the fully developed project will have on prior water rights holders within the area of influence (KPB CMP Enforceable Policy 5.2).
- To the extent feasible and prudent, existing industrial facilities or areas and pipeline route shall be used to meet new requirements for exploration and production support bases, transmission/shipment (including pipelines and transportation systems), and distribution of energy resources (KPB CMP Enforceable Policy 5.3).
- Projects which require dredging, clearing or construction in productive habitats shall be designed to keep these activities to the minimum area necessary for the project (KPB CMP Enforceable Policy 5.4).
- Activities associated with oil and gas resource exploration, industrial development, or production shall minimize navigational interference and be located or timed to avoid potential damage to fishing gear. Offshore pipelines and other underwater structures will be located, designed or protected so as to allow fishing gear to pass over without snagging or otherwise damaging the structure or gear (KPB CMP Enforceable Policy 5.5).
- Pipelines and pipeline right-of-ways shall, to the extent feasible and prudent, be sited, designed, constructed, and maintained to avoid important fishing grounds and to minimize risk to fish and wildlife habitats from a spill, pipeline break, or other construction activities. Pipeline crossings of fishbearing waters and wetlands important to waterfowl and shorebirds shall incorporate mitigative measures, to the extent feasible and prudent, to minimize the amount of oil which may enter such waters as a result of a pipeline rupture or leak (KPB CMP Enforceable Policy 5.6).
- Geophysical surveys will, to the extent feasible and prudent, be located, designed, and constructed in a manner so as to avoid disturbances to fish and wildlife populations, habitats, and harvests. Seasonal restrictions, restrictions on the use of explosives, or restrictions relating to the type of transportation utilized in such operations will be included as necessary to mitigate potential adverse impacts (KPB CMP Enforceable Policy 5.9).
- Geophysical surveys in fresh and marine waters supporting fish or wildlife will require the use of energy sources such as airguns, gas exploders, or other sources that have been demonstrated to be harmless to fish and wildlife and human uses of fish and wildlife. Blasting for purposes other than geophysical surveys will be approved on a case-by-case basis after all steps have been taken to minimize impacts and when no feasible and prudent alternatives exist to meet the public need (KPB CMP Enforceable Policy 5.9).
- To the extent feasible and prudent, underwater pipelines shall be buried. If pipelines are not buried they shall be designed to allow for the passage of fishing gear, or the pipeline route shall be selected to avoid important fishing areas, and anadromous fish migration and feeding areas (KPB CMP Enforceable Policy 6.4).
- Projects in areas traditionally used for subsistence shall be located, designed, constructed, and operated to minimize adverse impacts to subsistence resources and activities (KPB CMP Enforceable Policy 11.2).
- All bank cuts, fills and exposed earthwork adjacent to a wetland or water body must be stabilized to prevent erosion and sedimentation which may occur during or after construction. Bank stabilization measures shall be designed and constructed to protect habitat values by including irregular bank contours and insuring that nearshore water velocities do not increase (KPB CMP Enforceable Policy 12.4).
- Seabird colony sites and haul-outs and rookeries used by sea lions and harbor seals (as identified in ADF&G Regional Guides or with the best available information at the time of project review) shall not be physically altered or disturbed by structures or activities in a manner that would preclude or interfere with continued ties in a manner that would preclude or interfere with continued use of these sites. To the extent feasible and prudent, development structures and facilities with a high level of noise, acoustical or visual disturbance shall

maintain a one-half mile buffer from identified use areas for sea lions, harbor seals, and marine birds during periods when these species are present (KPB CMP Enforceable Policy 12.7).

- Uses and activities within or adjacent to coastal waters shall not interfere with migration or feeding of whales. Interference refers to conduct or activities that disrupt an animal's normal behavior or cause a significant change in the activity of the affected animal (KPB CMP Enforceable Policy 12.8).
- If previously undiscovered artifacts or areas of historic, prehistoric, or archaeological importance are encountered during development activities, the site shall be protected from further disturbance and the State Historic Preservation Office shall immediately be notified to evaluate the site or artifacts (KPB CMP Enforceable Policy 14.2).

8.1.5 Consistency of Waste Discharges with Relevant Coastal Management Programs and Policies

The project is currently undergoing a coastal zone management consistency review by the Alaska Division of Governmental Coordination to ensure that there are no conflicts with coastal zone management objectives.

Based on the analysis presented in this ODCE, waste discharges associated with oil and gas production activities at the Osprey Platform in Cook Inlet appear to comply with relevant ACMP policies. This assessment is based on the following findings:

- Based on the analyses in Section 7 of the ODCE, opportunities for subsistence use of coastal resources are unlikely to be threatened by discharges from the Osprey Platform
- Coastal habitats will be managed to maintain the biological, physical, and chemical characteristics of the habitats which contribute to their capacity to support living resources. This finding is based on analyses in Sections 5 and 6 of the ODCE indicating that coastal habitats are unlikely to experience significant adverse impacts from discharges of drilling mud and cuttings.
- Offshore areas will be managed to maintain sport, commercial, and subsistence fisheries. This finding is based on analyses in Section 7 indicating that recreational, commercial, and subsistence harvests are unlikely to experience degradation from waste discharges.
- Estuaries, wetlands, and tideflats will not be adversely affected by toxic waste discharges. This finding is based on analyses in Section 3 indicating that any toxic substances in the discharges will be rapidly diluted and are not likely to be detectable in the vicinity of coastal habitats.
- Mixing and transport processes of high energy coasts will not be affected by discharges of drilling mud and cuttings.

8.2 SPECIAL AQUATIC SITES

Effects of discharges from the Osprey Platform on biologically important communities are evaluated in Sections 5 and 6.

The KPB CMP has identified two potential Areas Meriting Special Attention (AMSA) in the general area. The Chuitna Potential AMSA was nominated to recognize, encourage, and plan for major resource and related development while protecting the traditional lifestyle and natural environment of this area. The Nikiski Industrial Area was nominated as a potential AMSA due to increasing potential for land use conflicts between existing industrial uses and other uses. The CMP recommends that the KPB initiate a comprehensive development program for future development in the AMSA. The proposed project is not located within either of these AMSAs.

The State of Alaska manages several special areas within the immediate vicinity of the proposed project. These include the Trading Bay State Game Refuge to the north of the project area and the Redoubt Bay Critical Habitat Area, which are both managed by the Alaska Department of Fish and Game. The proposed project is not located within either of these areas.

The Redoubt Bay Critical Habitat Area was founded in 1989 to ensure the protection and enhancement of fish and wildlife, particularly Tule geese. State lands, tidelands, and submerged lands are included in this area.

The Trading Bay State Game Refuge was established in 1976 to protect the following: fish and wildlife habitat, waterfowl nesting, feeding and migration, moose calving areas, spring and fall bear feeding areas, and salmon spawning and rearing habitats. The refuge includes state lands, tidelands, and submerged lands.

8.3 SUMMARY

Waste discharges associated with oil and gas production at the Osprey Platform in Cook Inlet are expected to be consistent with relevant ACMP policies. Discharges will be consistent with the objectives of subsistence uses of the coastal zone, management of coastal habitats, and management of specific habitat types (e.g., offshore areas). The project is currently undergoing a coastal zone management consistency review by the Alaska Division of Governmental Coordination to ensure that there are no conflicts with coastal zone management objectives.

9.0 MARINE WATER QUALITY CRITERIA

This section addresses compliance of oil and gas production discharges from the Osprey Platform with federal and State of Alaska water quality criteria and standards. Discharges to state waters in Cook Inlet must meet Alaska Water Quality Standards (18 AAC 70). For heavy metals, state standards are equivalent to federal water quality criteria. Compliance with these criteria must be met at the edge of the mixing zone. State policy allows discretionary determination of the size of mixing zones considering characteristics of receiving waters, effluents, and impacts on water quality.

Alaska marine water quality standards for the protection of aquatic life (18 AAC 70) include the following:

- Temperature: Discharges may not cause the weekly average temperature to increase more than 1°C. The maximum rate of change may not exceed 0.5°C per hour. Normal daily temperature cycles may not be altered in amplitude or frequency.
- Dissolved Inorganic Substances: Discharges may not increase the natural salinity by more than 4 parts per thousand (ppt) for waters with natural salinity between 13.5 to 35.0 ppt (as in the Forelands area of Cook Inlet).
- Sediment: Discharges may not cause a measurable increase in concentration of settleable solids above natural conditions, as measured by the volumetric Imhoff cone method.
- Toxics and Other Deleterious Organic and Inorganic Substances: Individual substances in the discharges may not exceed federal EPA Quality Criteria for Water (USEPA 1999b). There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, toxic effects on aquatic life, except as authorized. Substances may not be present in concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassay or organoleptic tests.
- Color: Color or apparent color may not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life. For all waters without a seasonally established nor for aquatic life, color or apparent color may not exceed 50 color units or the natural condition, whichever is greater.
- Petroleum Hydrocarbons, Oil and Grease: Total aqueous hydrocarbons in the water column may not exceed 15 µg/L. Total aromatic hydrocarbons in the water column may not exceed 10 µg/L. There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.
- Radioactivity: The discharges may not exceed the concentration specified in the Alaska Drinking Water Standards (18 AAC 80).
- Total Residual Chlorine: Concentrations may not exceed 2.0 ug/L for salmonid fish, or 10.0 ug/L for other organisms.

- Residues: The discharges may not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use, or cause acute or chronic problem levels as determined by bioassay or other appropriate methods. The discharges may not, alone or in combination with other substances, cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines; cause leaching of toxic or deleterious substances; or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines.

The Osprey Platform will not be authorized to discharge drilling muds, cuttings, or produced water. Discharges to state waters will include sanitary waste, domestic waste, deck drainage, non-contact cooling water, boiler blowdown, fire control system test water, and excess cement slurry.

The volume and concentrations of pollutants in the waste discharges from the Osprey Platform are expected to be minimal (SAIC 2001b). All discharges are expected to meet human health water quality criteria at the end-of-pipe, as well as water quality criteria for the protection of aquatic life. Therefore, there is little potential for discharges to exceed marine water quality criteria.

10.0 DETERMINATION OF UNREASONABLE DEGRADATION

Section 1 of this ODCE provides the regulatory definition of unreasonable degradation of the marine environment (40 CFR 125.12[e]) and indicates the ten criteria which are to be considered when making this determination (40 CFR 125.122). The actual determination of whether the discharge will cause unreasonable degradation is made by the U.S. EPA Regional Administrator. The intent of this chapter is to briefly summarize information pertinent to the determination of unreasonable degradation. Each of the ten criteria are discussed below.

10.1 CRITERION 1

The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged;

- Deck drainage and non-contact cooling water represent relatively high volume discharges (e.g., over 100,000 gpd), however pollutant concentrations in these discharges (primarily oil and grease) are anticipated to be low.
- About 2,020 gpd of sanitary waste will be discharged from the Osprey Platform; pollutants include BOD_5, fecal coliform, suspended solids, and residual chlorine. Concentrations are anticipated to be low, however, and in accordance with Alaska water quality standards.
- The remaining discharges (domestic waste, boiler blowdown, fire control test water, and excess cement slurry) are low in volume or intermittent and/or contain minimal concentrations of contaminants.
- Due to the minimal pollutant concentrations and/or low volume of the discharges, the potential for bioaccumulation or persistence of contaminants is low.

10.2 CRITERION 2

The potential transport of such pollutants by biological, physical, or chemical processes;

- The Forelands area of Cook Inlet has been demonstrated to be a non-depositional, high-energy environment characterized by a cobble and sand bottom. Fast tidal currents and tremendous mixing produce rapid dispersion of the minimal concentrations of soluble and particulate pollutants. It is expected that pollutants in the sanitary and other waste streams will be dissipated to undetectable concentrations within a few feet of the discharge.

10.3 Criterion 3

The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain;

- Low concentrations of BOD and nutrients in the sanitary waste discharge could stimulate primary productivity and enhance zooplankton production. This effect is predicted to be negligible.
- Threatened and endangered species that could occur near the project site include: Steller's eider, short-tailed albatross, fin whale, humpback whale, blue whale, northern right whale, and Steller sea lion. Most of these species are only occasional or accidental visitors to the Forelands area; they are unlikely to be affected by discharges from the Osprey Platform.
- A small number of Steller sea lions may occur near the project area, although no rookeries or haul-out areas have been identified in the project area. Wastewater discharges will be diluted by the strong tidal flux of Cook Inlet and are unlikely to adversely affect Steller sea lions or their critical habitat.
- Beluga whales have been identified as depleted under the Marine Mammal Protection Act. Belugas congregate at the mouths of rivers in Cook Inlet for calving and feeding; they disperse along the coastline of the upper and central inlet in late summer. Most belugas appear to move into the lower inlet during winter. The West Foreland area is not heavily used by beluga whales. Because the discharges will be rapidly dispersed, it is unlikely that they would directly or indirectly affect Cook Inlet belugas or their critical habitat.

10.4 Criterion 4

The importance of the receiving water to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism;

- Anadromous fish migrate through Cook Inlet towards spawning habitat in rivers and streams, and juveniles travel through Cook Inlet toward marine feeding areas. The Susitna River drainage is a primary sources of these anadromous fish in Cook Inlet. Eulachon also return to spawn in some of the rivers. Because the waste discharges will be rapidly dispersed, it is unlikely that they would adversely affect migrating anadromous fish.
- Cook Inlet is an important area for marine mammals including beluga whales, Steller sea lions, and harbor seals. No harbor seal haulout areas have been identified in the vicinity of the West Foreland. No adverse impacts from the Osprey Platform waste discharges is predicted.
- Lower Cook Inlet is one of the most productive areas for seabirds in Alaska, with an estimated 100,000 seabirds; 18 species breed in Cook Inlet.

- Waterbirds and waterfowl breed in the Cook Inlet region. In the spring, large numbers of waterbirds migrate through the area. Large populations of staging waterfowl are found on tidal flats, along river mouths, and in bays on the west side of the inlet including Redoubt Bay. Redoubt Bay has particularly high concentrations of geese and ducks.
- Several waterfowl species occurring in Cook Inlet are of particular concern due to their limited breeding distribution, small population size, or use of critical habitats. These are: trumpeter swan, Tule white-fronted goose, and snow goose. Trumpeter swans and Tule white-fronted geese breed in Redoubt Bay.
- Due to the rapid dispersion of waste discharges from the Osprey Platform, no adverse impacts on birds are predicted.

10.5 Criterion 5

The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs;

- Redoubt Bay Critical Habitat Area is located just south of the Osprey Platform along the west coast of Cook Inlet. During summer, it is the nesting ground of the Tule white-fronted goose as well as several tens of thousands of breeding ducks. Due to the relatively low volume and concentrations of waste discharges from the Osprey Platform, as well as their rapid dispersion, no adverse impacts on birds at the Redoubt Bay Critical Habitat Area is predicted.
- Trading Bay State Game Refuge is located about 6 miles north of the Osprey Platform. It was established to protect fish and wildlife habitat and populations, particularly waterfowl nesting, feeding, and migration areas; moose calving areas; spring and fall bear feeding areas; and salmon spawning and rearing habitats. Given the refuge's distance from the Osprey Platform and the rapid dispersion of pollutants in the waste discharges, no adverse effects are predicted.
- No critical habitat for endangered or threatened species has been identified in the project area by the National Marine Fisheries Service.
- Two potential Areas Meriting Special Attention (AMSA) are located in the general area: the Chuitna Potential AMSA and the Nikiski Industrial Area. The proposed project is not located within either of these AMSAs.

10.6 Criterion 6

The potential impacts on human health through direct and indirect pathways;

- Wastewater discharges from the Osprey Platform are not predicted to result in significant impacts to human health due to the small volume and low concentration of pollutants in the discharges.

10.7 CRITERION 7

Existing or potential recreational and commercial fishing, including finfishing and shellfishing;

- Nearshore locations used for commercial, subsistence, and recreational fisheries are predominantly outside areas that could conceivably be impacted by activities conducted during drilling and production at the Osprey Platform.

10.8 CRITERION 8

Any applicable requirements of an approved Coastal Zone Management Plan;

- Waste discharges from the Osprey Platform are expected to be consistent with relevant Alaska Coastal Management Program policies and with the Kenai Peninsula Borough Coastal Management Program.

10.9 CRITERION 9

Such other factors relating to the effects of the discharge as may be appropriate;

- No other factors have been identified relating to the effects of the discharge.

10.10 CRITERION 10

Marine water quality criteria developed pursuant to Section 304(a)(1).

- The waste discharges from the Osprey Platform are expected to comply with all marine water quality criteria.

11.0 REFERENCES

ADFG. 1985. Alaska habitat management guides. Southcentral Region, Volume III: Map atlas. Division of Habitat. Juneau, AK.

ADFG. 1986. Distribution, Abundance, and Human use of Fish and Wildlife – Alaska Habitat Management Guide, Southcentral Region, Volume II. Alaska Department of Fish and Game, Habitat Division, Juneau, Alaska.

ADFG. 1994. Trading Bay State Game Refuge and Redoubt Bay Critical Habitat Area Management Plan. Alaska Department of Fish and Game. Anchorage, Alaska. 135 p.

ADFG. 1999. Upper Cook Inlet Commercial Fisheries Annual Management Report, 1998. Regional Information Report No. 2A99-21.

Agler, B.A., S.J. Kendall, P.E. Seiser, and D.B. Irons. 1995. Estimates of marine bird and sea otter abundance in Lower Cook Inlet, Alaska during summer 1993 and winter 1994. U.S. Minerals Management Service. Alaska Outer Continental Shelf (OCS) Study; MMS 94-0063:xii. 122 p..

AKNHP. 2000. www.uaa.alaska.edu/enri/aknhp_web/biodiversity/zoological/spp_of_concern/spp_status_ reports/albatross/albatros.html#distribution. Alaska National Heritage Program, Anchorage, AK

Amundsen, J. 2000. Letter from John Amundsen of Forcenergy, Inc. to Christine Cook of U.S. EPA Region 10 re: submittal of revised NPDES permit application for the Redoubt Shoal Production operation. Letter dated February 29, 2000.

Amundsen, J. 2000b. Letter from John Amundsen of Forcenergy Inc. to Matt Harrington of U.S. EPA Region 10 re: draft responses to EPA comments dated 12/22/99. Letter dated February 29, 2000.

Amundsen, J. 2001. Personal communication with Iris Winstanley of SAIC. March 13, 2001.

Antrobus, T. 7, 8, 14 December 2000. Personal Communication (telephone with C. Perham, LGL Alaska Research Associates, Inc.). U.S. Fish and Wildlife Service. Anchorage, AK.

AOU. 1997. Check-list of North American birds. 7th edition. American Ornithologists' Union, New York.

Arneson, P.D. 1980. Identification, documentation and delineation of coastal migratory bird habitat in Alaska. Final Report to Bureau of Land Management and National Oceanic Atmospheric Administration. Outer Continental Shelf Contract #03-5-022-69.

Avanti Corporation. 1992. Biological evaluation for the proposed NPDES General Permit for oil and gas exploration, development and production activities in Cook Inlet/Gulf of Alaska.

Report to U.S. Environmental Protection Agency and the Cadmus Group. Avanti Corporation, Vienna, VA. 53 pp.

Balogh, G. 1999. U.S. Fish and Wildlife Service, Wildlife Biologist. Record of Conversation. Appendix A. In: ADFG. 1983. Susitna Hydro Aquatic Studies Phase II Report. Synopsis of the 1982 Aquatic Studies and Analysis of Fish and Habitat Relationships.

Barlow, J. and T. Gerrodette. 1996. Abundance of cetaceans in California waters based on 1991and 1993 ship surveys. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-233.

Barrett, B.M., F.M. Thompson, S.N. Wick. 1985. Adult salmon investigations, May – October 1984: Report No. 6. Alaska Department of Fish and Game.

Berzin, A.A., and A.A. Rovnin. 1966. The distribution and migrations of whales in the northeastern part of the Pacific, Chukchi, and Bering Seas. Pages 103-136 In: K.I. Panin (ed.), Soviet Research on Marine Mammals of the Far East.

Best, E.A., and W.H. Hardman. 1982. Juvenile halibut surveys, 1973-1980. International Pacific Halibut Commission, Seattle, WA.

Bigg, M.A. 1969. The harbour seal in British Columbia. Fish. Res. Bd. Can. Bull. 172. 33 p.

Bigg, M.A. 1981. Harbour seal, *Phoca vitulina*, Linnaeus, 1758 and *Phoca largha*, Pallas 1811,. Pages 1-27 In: S.H. Ridgeway and R.J. Harrison (eds.), Handbook of Marine Mammals, Vol. 2: Seals. Academic Press, New York.

Bishop, R.H. 1967. Reproduction, age determination and behavior of the harbor seal, *Phoca vitulina L.*, in the Gulf of Alaska. M.Sc. Thesis. University of Alaska, College, Alaska. 121 p.

Blackburn, J.E., K. Anderson, C.I. Hamilton, and S.J. Starr. 1979. Pelagic and demersal fish assessment in the lower Cook Inlet estuary system: final report. Alaska Department of Fish and Game.

Braham, H.W. 1984. Distribution and migration of gray whales in Alaska. Pages 249-266 In: The Gray Whale. M. L. Jones, S. L. Swartz, and S. Leatherwood (eds.). Academic Press, New York.

Braham, H. 1986. An annotated bibliography of right whales, *Eubalaena glacialis*, in the North Pacific. Report International Whaling Commission, Special Issue 10:65-77.

Braham, H. 1992. Endangered whales: status update. Working document presented at a workshop on the status of California cetacean stocks (SOCC/14). 35 p.

Braham, H.W. and M. E. Dahlheim. 1982. Killer whales in Alaska documented in the Platforms of Opportunity Program. Report of the International Whaling Commission 32:643-646.

Braham, H. and D. W. Rice. 1984. The right whale, *Eubalaena glacialis*. Marine Fisheries Review 46:38-44.

Braham, H.W., R.D. Everitt and D.J. Rugh. 1980. Northern sea lion decline in the Eastern Aleutian Islands. Journal of Wildlife Management 44:25-33.

Brandsma, M. 1999. Drilling Mud and Cuttings Discharge Modeling for Forcenergy Inc's Cook Inlet Project. Final Report. Prepared by Brandsma Engineering, September 29, 1999.

Brower, W.A., Jr., R.G. Baldwin, C.N. Williams, J.L. Wise, and L.D. Leslie. 1988. Climatic Atlas of the Outer Continental Shelf Waters and Coastal Regions of Alaska, Vol. I, Gulf of Alaska. RU 672. OCS Report, MMS 87-0013.

Brueggeman, J. J., G. A. Green, R. W. Tressler, and D. G. Chapman. 1988. Shipboard surveys of endangered cetaceans in the Northwest Gulf of Alaska. Contract no. 85-ABC-00093. Anchorage, AK: USDOI, MMS, Alaska OCS Region, and USDOC/NOAA, Office of Marine Assessment. Prepared by EnviroSphere Company.

Brueggeman, J. J., G. A. Green, K. C. Balcomb, C. E. Bowlby, R. A. Grotefendt, K. T. Briggs, M. L. Bonnell, R. G. Ford, D. H. Varoujean, D. Heinemann, and D. G. Chapman. 1990. Oregon-Washington marine mammal and seabird survey: Information synthesis and hypothesis formation. U. S. Department of the Interior, Outer Continental Shelf Study, Minerals Management Service 89-0030.

Buckland, S. T., K. L. Cattanach, and R.C. Hobbs. 1993. Abundance estimates of Pacific white sided dolphin, northern right-whale dolphin, Dall's porpoise and northern fur seal in the North Pacific, 1987/90. Pages 387-407 In: W. Shaw, R. L. Burgner, and J. Ito (eds.), Biology, distribution and stock assessment of species caught in the high seas driftnet fisheries in the North Pacific Ocean. International North Pacific Fisheries Commission Symposium; 4-6 November 1991, Tokyo, Japan.

Burns, J.E. and G. A. Seaman. 1986. Investigations of belukha whales in coastal waters of western and northern Alaska. II. Biology and ecology. U. S. Dep. Commer., NOAA, OCSEAP Final Rep. 56;221-357.

Burns, J.E., K.J. Frost, G. Seaman, and L.F. Lowry. 1985. Biological investigations of belukha whales in waters of western and northern Alaska. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of the Principal Investigators, RU 232, Volume I Biological Studies. Juneau, Alaska: USDOC, NOAA, OCSEAP, and USDOI, BLM. 57 p.

Byrnes, P. E. and W. R. Hood. 1994. First account of Steller sea lion (*Eumetopias jubatus*) predation on California sea lion (*Zalophus californianus*). Marine Mammal Science 10:381-383.

Cahalane, V.H. 1944. Birds of the Katmai Region, Alaska. Ak. 61:351-375.

Calambokidis, J. G. H. Steiger, J. M. Straley, T. Quinn, L. M. Herman, S. Cherchio, D. R. Salden, M. Yamaguchi, F. Sato, J. R. Urban, J. Jacobson, O. Von Zeigesar, K. C. Balcomb, C. M. Gabriele, M. E. Dahlheim, N. Higashi, S. Uchida, J. K. B. Ford, Y. Miyamura, P. Ladron de Guevara, S. A. Mizroch, L. Schlender, and K. Rasmussen. 1997. Abundance and population structure of humpback whales in the North Pacific Basin. Final Contract Report 50ABNF500113 to Southwest Fisheries Science Center, La Jolla CA.

Calkins, D.G. 1983. Marine mammals of lower Cook Inlet and the potential form impact from outer continental shelf oil and gas exploration, development, and transport. U.S. Dept. of Comm., NOAA. OCSEAP Final Report 20:171-265.

Calkins, D.G. 1986. Marine Mammals. Pages 527-558 in D.W. Hood and S.T. Zimmerman. Eds. The Gulf of Alaska: physical environment and biological resources. U.S. Dep. Of Comm. NOAA/OCS, USDOI/MMS 86-0095.

Calkins, D.G. 1989. Status of beluga whales in Cook Inlet. In: Proceedings of the Gulf of Alaska, Cook Inlet, and North Aleutian Basin Information Update Meeting, Anchorage, Alaska, February 7-8 1989. OCS Study, MMS 89-0041. Anchorage, AK: USDOI/MMS, and USDOC/NOAA.

Campbell, B.H. and T.C. Rothe. 1985. Spring goose migration in Cook Inlet. Pages 28-29 in Annual report of survey-inventory activities. Vol. XV. Waterfowl. Alaska Dept. of Fish and Game. Juneau.

Campbell, B.H. and T.C. Rothe. 1986. Spring goose migration in Cook Inlet. Pages 33-36 in Annual report of survey-inventory activities. Vol. XVI. Waterfowl. Alaska Dept. of Fish and Game. Juneau.

Carretta, J. V. M. S. Lynn, and C. A. LeDuc. 1994. Right whale *Eubalaena glacialis*, sightings off San Clemente Island California. Marine Mammal Science 10:101-104.

Consiglieri, L.D. and H.W. Braham. 1982. Seasonal distribution and relative abundance of marine mammals in the Gulf of Alaska. U.S. Dept. of Comm., NOAA. OCSEAP Research Unit 68 Partial Final Rep. 212 p.

Cottom, C. 1939. Food habits of North American diving ducks. U.S. Dept. Agri., Tech. Bull. 643:88-93.

Dahlheim, M. E., D. Ellifrit and J. Swenson. 1997. Killer whales of Southeast Alaska: a catalogue of photo-identified individuals. Day Moon Press, Seattle Washington 82 p.

Dahlheim, M., A. York, R. Towell, and J. Waite. Submitted. Abundance and distribution of Alaska harbor porpoise based on aerial surveys: Bristol Bay to Southeast Alaska. Mar. Mamm. Sci.

Darling, J. D. 1991. Humpback whales in Japanese waters. Ogasawara and Okinawa. Fluke identification catalog 1987-1990. Final Contract Report, World Wide Fund for Nature, Japan. 22 p.

DeGrange A.R. 1981. The Short-tailed Albatross, *Diomedea Albatrus*, its status, distribution and natural history. Office of Endangered Species, Anchorage, AK.

DeGange A.R., and G.A. Sanger. 1987. Marine birds. Pages 479-524 In: The Gulf of Alaska Physical Environment and Biological Resources, D.W. Hood and S.T. Zimmerman, eds. RU's 655/656. OCS Study, MMS 86-0095. Anchorage, AK: USDOC, NOAA, and USDOI, MMS, Alaska OCS Region.

Dohl, T. P. K. S. Norris, R. C. Guess, J. P. Bryant, and M. W. Honig. 1981. Summary of marine mammals and seabird surveys of the southern California bight area, 1975-1978. Volume III, Part II-Cetaceans. Final Report, Los Angeles, California: USDOI/BLM, Pacific OCS Office.

Eagleton, M. 13 December 2000. Personal Communication (telephone with C. Perham, LGL Alaska Research Associates, Inc.). National Marine Fisheries Service. Anchorage, AK.

Edie, A.G. 1977. Distribution and movements of Steller sea lion cows (*Eumetopias jubatus*) on a pupping colony. Masters Thesis, University of British Columbia, Vancouver, British Columbia, Canada. 81 p.

Erikson, D. 1976. Distribution, abundance, migration and breeding locations of marine birds-Lower Cook Inlet, Alaska, 1976. Unpublished Report. Alaska Department of Fish and Game, Anchorage, AK. 82 p.

Fall, J. 1993. Personal Communications, April 20, 1993. As cited in NCG 2001.

Fall, J., D. Foster, and R. Stanek. 1984. The Use of Fish and Wildlife Resources in Tyonek, Alaska. Alaska Department of Fish and Game. Division of Subsistence, Technical Paper Series (105).

Farrand, J. (ed.). 1983. Loons to sandpipers. The Audubon Society Master Guide to Birding. Alfred A. Knopf, New York, NY. 437 p.

Fechhelm, R.G., W.J. Wilson, W.B. Griffiths. 1999. Forage Fish Assessment in Cook Inlet Oil and Gas Development Areas, 1997–1998. Prepared for U.S. Department of the Interior. Minerals Management Service, Anchorage, AK. Prepared by LGL Alaska Research Associates, Inc. Anchorage, AK.

Feder, H. M., and S.G. Jewett. 1987. The Subtidal Benthos. Pages 347-396. In: The Gulf of Alaska, Physical Environment and Biological Resources, S.T. Zimmerman and D.W. Wood, (eds.) OCS Study, MMS 86-0095. Washington, DC: USDOC, NOAA, and USDOI, MMS.

Feder, H.M., S.G. Jewett, S.G. McGee, and G.E.M. Matheke. 1981. Distribution, Abundance, Community Structure, and Trophic Relationships of the Benthos of the Northeastern Gulf of Alaska from Yakutat Bay to Cross Sound. Final report. Prepared by the University of Alaska, Fairbanks. Boulder, CO: USDOC NOAA OCSEAP.

Fitch, J. E., R.J. Lavenberg. 1975. Tidepool and nearshore fishes of California. Calif. Nat. Hist. Guides 38. University of California Press, Berkeley. 156 pp.

Fisher, H.D. 1952. The status of the harbour seal in British Columbia, with particular reference to the Skeena River. Fish. Res. Bd. Can. Bull. 93. 58 p.

Forsell, D.J. and P.J. Gould. 1981. Distribution and abundance of marine birds and mammals wintering in the Kodiak area of Alaska. U.S. Fish and Wildlife Service, Office of Biological Services. FWS/OBS-81/13. 81 p.

Gabrielson, I.N. and F.C. Lincoln. 1959. The birds of Alaska. The Stackpole Company and the Wildlife Management Institute, Harrisburg.

Gaskin, D. E. 1984. The harbor porpoise *Phocoena phocoena* (L.): Regional populations, status, and information on direct and indirect catches. Rep. Int. Whal. Comm. 34:569-586.

Gatto, L.W. 1976. Baseline Data on the Oceanography of Cook Inlet, Alaska. CRREL Report 76-25. Corps of Engineers, U.S. Army, Cold Regions Research and Engineering Laboratory. Hanover, New Hampshire.

Gentry, R. L. and J. H. Johnson. 1981. Predation by sea lions on northern fur seal neonates. Mammalia 45:423-430.

Gorbics, C.S., J.L. Garlich-Miller and S.L. Schliebe. 1998. Sea otter (*Enhydra lutris*): Southcentral Alaska Stock. Pages 9-13 In: Draft Alaska marine mammal stock assessments 1998: sea otters, polar bear and walrus. Marine Mammals Management. U.S. Fish and Wildlife Service. Anchorage, Alaska.

Gurevich, V.S. 1980. Worldwide distribution and migration patterns of the white whale (beluga), *Delphinapterus leucas*. Report of the International Whaling Commission 30:465-480.

Hall, J. 1979. A survey of cetaceans of Prince William Sound and adjacent waters-their numbers and seasonal movements. Unpublished report to Alaska Outer Continental Shelf Environmental Assessment Programs. NOAA OCSEAP Juneau Project Office, Juneau, Alaska. 37 p.

HCG. 2000a. Fourth Quarter 1999 Data Report (October-December) for the Meteorological Monitoring Program for the Kustatan Production Facility. Prepared for Forcenergy, Inc.

HCG. 2000b. First Quarter 2000 Data Report (January-March) for the Meteorological Monitoring Program for the Kustatan Production Facility. Prepared for Forcenergy, Inc.

HCG. 2000c. Second Quarter 1999 Data Report (April-June) for the Meteorological Monitoring Program for the Kustatan Production Facility. Prepared for Forcenergy, Inc.

HCG. 2000d. Third Quarter 1999 Data Report (July-September) for the Meteorological Monitoring Program for the Kustatan Production Facility. Prepared for Forcenergy, Inc.

Hart, J.L. 1973. Pacific fishes of Canada. Fisheries Research Board of Canada, Bulletin No. 180. Ottawa. 740 p.

Hill, P.S., D.P. DeMaster, and R.I. Small. 1997. Alaska Marine Mammal Stock Assessments, 1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC- 78, 150 p.

Hill, P.S., and D.P. DeMaster. 1999. Alaska Marine Mammal Stock Assessments 1999. National Marine Mammal Laboratory.

Hill, P.S. and D.P. DeMaster. 2000. Alaska marine mammal stock assessments 1999. National Marine Mammal Laboratory, Seattle Washington, 174 p.

Hood, D.W., and S.T. Zimmerman (eds.). 1987. The Gulf of Alaska, Physical Environment and Biological Resources. U.S. Department of Commerce/NOAA.

Horwood, J. 1990. Biology and exploitation of the minke whale. CRC Press, Inc., Boca Raton Florida. 238 p.

IPHC. 1998. The Pacific Halibut: Biology, Fishery, and Management. International Pacific Halibut Commission. Technical Report No. 40.

IPHC. 1999. www.iphc.washington.edu/staff/tracee/STABtable99.htm. International Pacific Halibut Commission, Anchorage, AK

Johnson, J.H. and A.A. Wolman. 1984. The humpback whale (*Megaptera novaeangliae*). Marine Fisheries Review. 46:30-37.

Jones, M.L. and S.L. Swartz. 1984. Demography and phenology of gray whales and evaluation of whale-watching activities in Laguna San Ignacio, Baja California Sur, Mexico. Pages 309-374 In: M.L. Jones et al. (eds.), The gray whale *Eschrichtius robustus*. Academic Press, Orlando, FL. 600 pgs.

Jones and Stokes. 1989. Fates and effects of exploratory phase oil and gas drilling discharges in the Beaufort Sea Planning Area, Lease Sale 124. Prepared for U.S. Environmental Protection Agency. Jones and Stokes Associates, Bellevue, WA. As cited in: Tetra Tech 1994.

Kajimura, H. and T. R. Loughlin. 1988. Marine Mammals in the oceanic food web of the eastern subarctic Pacific. Bulletin of Ocean Resources Institute 26:187-223.

Kenyon, K.W. and D.W. Rice. 1961. Abundance and distribution of the Steller sea lion. Journal of Mammalogy 42:223-234.

Kessel, B. 1989. Birds of the Seward Peninsula, Alaska: their biogeography, seasonality, and natural history. Univ. Alaska, Fairbanks Press. 330 p.

Kinney, P.J., J. Groves, and D.K. Button. 1970. Cook Inlet Environmental Data. R/V Acona Cruises 065, May 21-28, 1968. Report No. R-70-2. Fairbanks, AK: UAF, 122 p.

Klinkhart, E.G. 1966. The Beluga whale in Alaska. Alaska Dep. Fish and Game, Juneau, Fed. Aid Wildl. Restor. Proj. Rep. Vol. VII, Proj. W-6-R and W-14-R. 11 p.

Kobayashi, K. 1961. Larvae and young of the sand-lance. *Ammodytes hexapterus* Pallas from the North Pacific. Bull. Facu. Fish., Hokkaido University. 12(2):111-120.

Kenai Peninsula Borough (KPB). 1990. Kenai Peninsula Borough Coastal Management Program. Final Document, June 1990. Prepared by Kenai Peninsula Borough Resource Planning Department.

Larrance, J. D., D. A. Tennant, A.J. Chester, and P.A. Ruffio. 1977. Phytoplankton and primary productivity in the northeast Gulf of Alaska and lower Cook Inlet. Pages 2-64 In: Annual reports of principal investigators for the year ending March 1977, volume 10. Environmental assessment of the Alaskan continental shelf, outer continental shelf environmental assessment program, U.S. Department of Commerce and U.S. Department of Interior, Boulder, CO.

Leatherwood, S., R. R. Reeves, W. F. Perrin, and W. E. Evans. 1982. Whales dolphins, and porpoises of the eastern North Pacific and adjacent arctic waters: a guide to their identification. U.S. Department of Commerce, NOAA Technical Report NMFS Circular 444, 425 p.

Loughlin, T. R., D. J. Rugh, and C. H. Ficus. 1984. Northern sea lion distribution and abundance: 1956-1980. Journal of Wildlife Management 48:729-740.

Lowry, L.F., K.J. Frost, D.G. Calkins, J.L. Swartzman, and S. Hills. 1982. Feeding habits, food requirements, and status of Bering Sea marine mammals. Final Report to North Pacific Fisheries Management Council, Anchorage, AK. 154 p.

Mathisen, O.A., R.T. Baade, and R.J. Lopp. 1962. Breeding habits, growth and stomach contents of the Steller sea lion in Alaska. Journal of Mammalogy 43:469-477.

Mathisen, O.A. and R.J. Lopp. 1963. Photographic census of the Steller sea lion herds in Alaska. U.S. Fish and Wildlife Service Special Science Report Fisheries No. 424. 20 p.

McKinley, T. R. 1996. Angler Effort and Harvest of Chinook Salmon and Pacific Halibut in the Marine Recreational Fishery of Central Cook Inlet, 1995. Alaska Department of Fish and Game, Division of Sport Fish. Juneau, AK.

Merrick, R.L., T.R. Loughlin, and D.G. Calkins. 1987. Decline in abundance of the northern sea lion Eumetopias jubatus, in Alaska, 1956-86. Fisheries Bulletin U.S. 85:351-365.

Mills, M.J. 1992. Harvest, catch, and participation in Alaska sport fisheries during 1991. Fishery Data Series No. 92-40. Alaska Department of Fish and Game, Division of Sport Fish. Anchorage, Alaska. 190 p.

Mizroch, S. A., D. W. Rice, J. M. Breiwick. 1984. The Blue whale, *Balaenoptera musculus*. Marine Fisheries Review 46:15-19.

Mizroch, S. A. 1992. Distribution of minke whales in the North Pacific based on sightings and catch data. Unpublished document submitted to the International Whaling Commission. 37 p.

MMS. 1984. Public Hearing on DEIS for the Diapir Field Lease Offering (6/84), 10/24/83, USDOI-Minerals Management Service, Alaska OCS Region, Barrow, Alaska.

MMS. 1995. Alaska Outer Continental Shelf Cook Inlet Planning Area Oil and Gas Lease Sale 149. Draft Environmental Impact Statement. OCS EIS/EA MMS 94-0066. U.S. Dept. of the Interior, Minerals Management Service, Alaska Outer Continental Shelf, Anchorage, AK.

MMS. 1996a. Alaska Outer Continental Shelf Cook Inlet Planning Area Oil and Gas Lease Sale 149, Final Environmental Impact Statement. OCS EIS/EA MMS 95-0066. U.S. Dept. of the Interior, Minerals Management Service, Alaska Outer Continental Shelf, Anchorage, AK.

MMS. 1996b. Alaska Outer Continental Shelf Beaufort Sea Planning Area Oil and Gas Lease Sale 144, Final Environmental Impact Statement. OCS EIS/EA MMS 96-0012. U.S. Dept. of the Interior, Minerals Management Service, Alaska Outer Continental Shelf, Anchorage, AK.

MMS. 1996c. Outer continental shelf oil and gas leasing program: 1997-2002 Final Environmental Impact Statement, lower Cook Inlet/Shelikof Strait proposed outer continental shelf oil and gas lease sale 60. OCS EIS/ES MMS 96-0043. U.S. Dept. of Interior, Minerals Management Service, Bureau of Land Management, Alaska Outer Continental Shelf Office, Anchorage, AK.

Montgomery Watson. 1993. Sunfish Project – Existing Environment and Issues Analysis. Report to ARCO Alaska, Inc. by Montgomery Watson, Anchorage, AK.

Morris, R.J. 1992. Status Report on Cook Inlet Belugas (*Delphinapterus leucas*). National Marine Fisheries Service (NMFS), Anchorage Field Office, AK. 23 p.

Morrow, J.E. 1980. The freshwater fishes of Alaska. Alaska Northwest Pub. Co., Anchorage, AK.

Northern Consulting Group (NCG). 2001. Environmental Information Document, Redoubt Shoal Unit Development Project, Cook Inlet, Alaska. Prepared for Forest Oil Corporation (formerly Forcenergy, Inc.), Anchorage Alaska. Prepared by Northern Consulting Group, Anchorage, Alaska. January 2001.

Nemoto, T. 1959. Food of baleen whales with reference to whale movements. Scientific Report of the Whales Research Institute 14:149-291.

Nerini, M. 1984. A review of gray whale feeding ecology. Pages 423-450 In: M.L. Jones, S.L. Swartz and S. Leatherwood (eds.), The gray whale *Eschrichtius robustus*. Academic Press, Orlando, FL. 600 p.

Nishiwaki, M. 1966. Distribution and migration of the larger cetaceans in the North Pacific as shown by Japanese whaling results. Pages 172-191 In: K. S. Norris (ed.) Whales, dolphins, and porpoises, University of California Press, Berkeley, CA.

NMFS. 1991. Recovery plan for the humpback whale (*Megaptera novaeangliae*). Prepared by the Humpback Recovery Team for the National Marine Fisheries Service, Silver Spring MD. 105 p.

NMFS. 1992. Recovery plan for the Steller sea lion (*Eumetopias jubatus*). Prepared by the Steller Sea Lion Recovery Team for National Marine Fisheries Service, Silver Spring, MD. 92 p.

NMFS. 1995. Status review of the United States Steller sea lion (*Eumetopias jubatus*) population. Prepared by the National Marine Mammal Laboratory, Alaska Fisheries Science Center, Seattle, Washington. 45 p.

NMFS. 2000a. 2000 Beluga whale tagging. National Marine Fisheries Service, nmml.afsc.noaa.gov/CetaceanAssessment/BelugaTagging/2000_Folder/2000_beluga_whale_tagging.htm.

NMFS. 2000b. Federal actions associated with management and recovery of Cook Inlet beluga whales. Draft Environmental Impact Statement, October 2000. National Marine Fisheries Service, Anchorage, AK. 99 p.

NMFS. 2000c. Steller sea lion major haulout concentrations, http//nmml.afsc.noaa.gov/Alaska Ecosystems/sslhome/Buffer.htm. National Marine Fisheries Service, Anchorage, AK.

NOAA. 1999. National Oceanic and Atmospheric Administration, National Ocean Service, Center for Operational Oceanographic Products and Services, http//co-ops.nos.noaa.gov/.

O'Harra, D. 2001 Jan. 19. Count sees no decline in belugas. Anchorage Daily News; Sect. B:1.

Ohsumi, S. 1958. Growth of fin whales in the Northern Pacific. Scientific Reports of the Whales Research Institute 13: 97-133.

Orr, R.T. and T.C. Poulter. 1967. Some observations on reproduction, growth, and social behavior in the Steller sea lion. Proceedings of the California Academy of Science 35:193-226.

Palmer, R.S. (ed.). 1976. Handbook of North American birds. Vol. 3. Yale Univ. Press, New Haven. 521 p.

Pascual, M.A. and M.D. Adkinson. 1994. The decline of the Steller sea lion in the northeast Pacific: demography, harvest, or environment? Ecological Applications. 4:393-403.

Peterson, M.R. 1981. Populations, feeding ecology, and molt of Steller's eiders. Condor 83:256-262.

Pitcher, K. W. 1981. Prey of the Steller sea lion, *Eumetopias jubatus*, in the Gulf of Alaska. Fisheries Bulletin 79:467-472.

Pitcher, K. W. and F. H. Fay. 1982. Feeding by Steller sea lions on harbor seals. Murrelet 63: 70-71.

Pitcher, K.W. and D.G. Calkins. 1981. Reproductive biology of Steller sea lions in the Gulf of Alaska. Journal of Mammalogy 62:599-605.

Poole, F.W. and J.L. Hufford. 1982. Meteorological and Oceanographic Factors Affecting Sea Ice in Cook Inlet. Journal of Geophysical Research. 87C3:2061-2070.

Rehberg, M.J. 2001. Personal Communication between Michael J. Rehberg of Alaska Department of Fish and Game and Craig Perham of LGL Associates. March 20, 2001.

Rice, D. W. 1974. Whales and whale research in the eastern North Pacific. pp 170-195 In: The whale problem: a status report. W. E. Schevill (ed.) Harvard University Press, Cambridge, MA.

Rice, D.W. and A.A. Wolman. 1971. The life history and ecology of the gray whale (Eschrichtius robustus). Am. Soc. Mamm. Spec. Publ. 3. 142 p.

Roberson, D. 1980. Rare birds of the west coast of North America. Woodstock Publications, Pacific Grove, CA. Pp. 6-9.

Rosenberg, D.H. 1986. Wetland types and bird use of Kenai lowlands. Unpubl. rep. by U.S. Fish and Wildlife Service, Special Studies, Anchorage, AK. 189 pp.

Rotterman, L.M., and T. Simon-Jackson. 1988. Sea otter (*Enhydra lutris*). Pp. 237-275 in J.W. Lentfer (ed.). Selected marine mammals of Alaska: species accounts with research and management recommendations. Marine Mammal Commission, Washington, D.C.

Rugh, D.J., K.E.W. Shelden, B.A. Mahoney, and L.K. Litzky. 2000. Aerial surveys of beluga in Cook Inlet, Alaska, June 2000. http://www.fakr.noaa.gov/protectedresources/whales/aerial2000survey.pdf.

SAIC. 2001a. Biological Assessment for Wastewater Discharges Associated with the Osprey Platform in the Redoubt Shoal Unit Development Project. Prepared for U.S. Environmental Protection Agency, Region 10 by Science Applications International Corporation with LGL Alaska Research Associates, Inc. March 16, 2001.

SAIC. 2001b. Draft Environmental Assessment for the New Source NPDES Forest Oil Redoubt Shoal Unit Production Oil and Gas Development Project, Cook Inlet, Alaska. Prepared for U.S. Environmental Protection Agency, Region 10 by Science Applications International Corporation. April 12, 2001.

Sambrotto, R.N. and C.J. Lorenzen. 1987. Phytoplankton and Primary Production. Pages 249-284. In: The Gulf of Alaska, Physical Environment and Biological Resources, Hood, D.W. and S.T. Zimmerman, eds. RU's 655/656, OCS Study, MMS 86-0075. Anchorage, AK: USDOC, NOAA and USDOI, MMS Alaska OCS Region.

Scarff, J.E. 1986. Historic and present distribution of the right whale, *Eubalaena glacialis*, in the eastern North Pacific south of 50 N and east of 180 W. Report to the International Whaling Commission, Special issue 10:43-63.

Scarff, J.E. 1991. Historic distribution and abundance of the right whale *Eubalaena glacialis* in the North Pacific, Bering Sea, Sea of Okhotsk, and Sea of Japan from the Maury Whale charts. Report of the International Whaling Commission 41:467-487.

Scheffer, V.B., and J.W. Slipp. 1944. The harbor seal in Washington state. Amer. Midl. Nat. 32:373-416.

Scott, W.B., and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada Bulletin 198. 966 p.

Sease, J. L. and T. R. Loughlin. 1999. Aerial and land based surveys of Steller sea lions (*Eumatopias jubatus*) in Alaska, June and July 1997 and 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-100, 61 pp.

Sherburne, J. 1993. Status report on the Short-tailed Albatross. Endangered Species Program Ecological Services, U.S. Fish and Wildlife Service.

Sheldon, K.E.W. 1993. Beluga Whales (*Delphinapterus leucas*) in Cook Inlet - A Review. Appended to Withrow, D.E. et al., 1993.

Small, R.J. 1996. Population assessment of harbor seals in Alaska: report of a workshop held in Fairbanks, Alaska, November 14-16. 1995. 36 pp.

Smith, B. 1999. National Marine Fisheries Service, Marine Mammal Biologist. Record of Conversation. Appendix A. In Environmental Information Document: Redoubt Shoal Unit Development Project Cook Inlet, Alaska. Revised draft for Forcenergy Inc. by Northern Consulting Group. Anchorage, Alaska.

Smith, B. and B. Mahoney. 1999. National Marine Fisheries Service, Marine Mammal Biologist. Record of Conversation. Appendix A. In Environmental Information Document: Redoubt Shoal Unit Development Project Cook Inlet, Alaska. Revised draft for Forcenergy Inc. by Northern Consulting Group. Anchorage, Alaska.

Stewart, B. S. and S. Leatherwood. 1985. Minke whale, Balaenoptera acutorostrata. pp 91-136 In: S. H. Ridgeway and R. Harrison (eds.) Handbook of Marine Mammals. Academic Press, London.

Swartz, S.L. and M.L. Jones. 1981. Demographic studies and habitat assessment of gray whales, *Eschrichtius robustus*, in Laguna San Ignacio, Baja California, Mexico. U.S. Mar. Mamm. Comm. Rep. MMC-78/03. 34 p. NTIS PB-289737.

Tarbox, K.E. and Thorne, R.E. 1996. ICES Journal of Marine Science. Assessment of adult salmon in near-surface waters of Cook Inlet, Alaska. p. 53.

Tetra Tech. 1994. Ocean discharge criteria evaluation for Cook Inlet (oil and gas lease 149) and Shelikof Strait. Prepared for U.S. Environmental Protection Agency, Region 10. Tetra Tech, Inc. Redmond, WA.

Tikhomirov, E. A. 1959. The feeding of the sea lion on warm-blooded animals. Izvestia TINRO 53:281-285.

Tomilin, A.G. 1967. Mammals of the U.S.S.R. and adjacent countries, Vol. 9 Cetacea (in Russian). NTIS Access No. TT65-50086. Moscow: Isdatel 'stvo Akademii Nauk SSR. Translated by Israel Program for Scientific Translation, 1967. 717 pp.

United Industries Group (UIG). 1998. Installation, Operation and Maintenance Manual. Offshore rig and platform wastewater treatment plants, USCG certified MSD type 11. Newport Beach, CA. 54 pp.

U.S. Army Corps of Engineers (USCOE). 1993. Deep Draft Navigation Report, Cook Inlet, Alaska. Alaska District.

USEPA. 1984. Revised Preliminary Ocean Discharge Criteria Evaluation, Gulf of Alaska-Cook Inlet, OCS Lease Sale 88 and State Lease Sales Located in Cook Inlet. U.S. Environmental Protection Agency Region 10, Prepared with assistance by: Jones & Stokes Associates, Inc. and Tetra Tech, Inc. September 28, 1984.

USEPA. 1994. Ocean Discharge Criteria Evaluation for Cook Inlet (Oil and Gas Lease Sale 149) and Shelikof Strait. Final Draft Report. TC 6616-07. Prepared for U.S. Environmental Protection Agency Region 10 by Tetra Tech, Inc. September 9, 1994.

USEPA. 1996. Fate and Effects of Exploratory Phase Oil and Gas Drilling Discharges in the Cook Inlet/Shelikof Strait Planning Area, Lease Sale 149. Draft EIS Appendix. Prepared by U.S. EPA Region 10 in association with Jones & Stokes Associates, Inc., Tetra Tech, Inc., and Science Applications International Corporation. October 30, 1994.

USEPA. 1999. Authorization to Discharge under the National Pollutant Discharge Elimination System for Oil and Gas Exploration, Development, and Production Facilities. Permit No. AKG28500. Issued March 10, 1999.

USEPA 1999b. National Recommended Water Quality Criteria – Correction. U.S. Environmental Protection Agency, Office of Water. EPA 822-Z-99-001. April 1999.

USFWS. 1992. Catalog of Alaskan seabird colonies – computer archives. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK.

USFWS. 2000. http//www/r7.fws.gov/es/steller/stei.pdf. United States Fish and Wildlife Service.

USFWS. 2001. http//news.fws.gov/newsreleases/display.cfm?NewsID=DB8D659A-E88F-11D4-A17E009027B6B5D3. United States Fish and Wildlife Service.

Wada, S. 1973. The ninth memorandum on the stock assessment of whales in the North Pacific. Report of the International Whaling Commission 23:164-169.

Watts, P. and D.E. Gaskin. 1985. Habitat index analysis of the harbor porpoise (*Phocoena phocoena*) in the southern coastal Bay of Fundy, Canada. J. Mamm. 66:733-744.

Williams, G. C., S. W. Richards, and E. G. Farnworth. 1964. Eggs of *Ammodytes hexapterus* from Long Island, New York. Copeia. 1964(1):242-243.

Wing, B.L. and K. Kreiger. 1983. Humpback whale prey studies in southeastern Alaska, summer 1982. Auke Bay, AK. USDOC/NOAA/NMFS/NWAFC, Auke Bay Laboratory. 51 pp.

Witherell, D. 1999. Status Trends of Principal Groundfish and Shellfish Stocks in the Alaska Exclusive Economic Zone, 1999. North Pacific Fishery Management Council, Anchorage, AK.

Withrow, D. E., and T.R. Loughlin. 1997. Abundance and distribution of harbor seals (Phoca vitulina richardsi) along the south side of the Alaska Peninsula, Shumagin Islands, Coon Inlet, Kenai Peninsula, and the Kodiak Archipelago in 1996. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring, MD 20910.

Withrow, D.E., K.E.W. Shelden, D.J. Rugh, and R.C. Hobbs. 1994. Beluga whale, Delphinapterus leucas, distribution and abundance in Cook Inlet, 1993. Pp. 128-153 In: H. Braham and D. DeMaster (eds.) Marine Mammal Assessment Program: Status of stocks and impacts of incidental take; 1993. Annual Rept. Submitted to Office of Protected Resources, NMFS, 1335 East-West Highway, Silver Spring, MD 153 pp.

Wolman, A.A. 1978. Humpback whale. In: Marine mammals of the eastern North Pacific and arctic waters. D. Haley (ed.). Seattle Washington, Pacific Search Press.

Würsig, B., E.M. Dorsey, M.A. Fraker, R.S. Payne, W.J. Richardson and R.S. Wells. 1984. Behavior of bowhead whales, *Balaena mysticetus*, summering in the Beaufort Sea: surfacing, respiration, and dive characteristics. Can. J. Zool. 62(10):1910-1921.

York, A.E. 1994. The population dynamics of northern sea lions, 1975-85. Marine Mammal Science 10:38-51.